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US Army Corps of Engineers®
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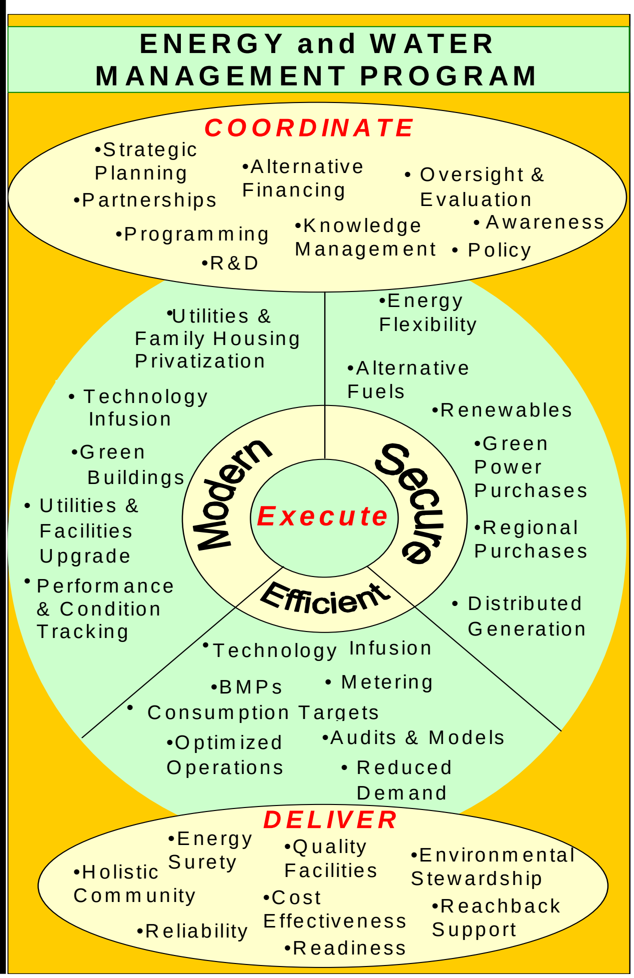
A Candidate Army Energy and Water Management Strategy

Donald F. Fournier and Eileen T. Westervelt

August 2004



Construction Engineering Research Laboratory

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A Candidate Army Energy and Water Management Strategy

Donald F. Fournier and Eileen T. Westervelt

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Final Report

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

ABSTRACT: Army installations are essential to the development and sustainment of operational capabilities and readiness to serve and protect the nation and its interests. Installations are small cities with a full complement of facility types and utility requirements that necessarily use significant amounts of energy and water. To secure its mission, the Army must competently manage these facilities and utility assets and their consumption of resources. The management of these resources is multi-faceted and must incorporate diverse issues into a cohesive program. This work augments on-going energy and water management initiatives within the Army by developing a new candidate Army level strategy that responds to anticipated legislation; reflects current DOD and DA requirements, vision, and values in light of the current world situation; incorporates sound science and management principles; and organizes and focuses efforts into an integrated program.

Executive Summary

The Army needs a more coordinated and comprehensive energy and water management program to meet the performance requirements and operational constraints that it faces. Continuing with the current decentralized mode of operation will not adequately address these challenges and will lead to situations that cannot be easily remedied. The Army must have a clear understanding of where we are with energy and water stewardship, where we want to be in the future, and how we are going to get there. Consensus values that guide our actions should be recognized and accepted. Army business processes must include more collaboration, review, feedback, and adjustments to make sure that decisions are appropriately informed and to lead us in the desired direction.

This candidate strategy outlines a management policy and operating framework that will allow the Army to meet its expanding requirements with tightening resources. It assesses our current status, describes a vision for the future with guiding principles, sets up an operational structure that organizes existing programs and highlights gaps that need to be filled. It establishes goals with supporting objectives, rationale, and tactical strategies. It recommends actions to improve outcomes in each operational element. An overall schematic of the proposed program (cf. Figure ES1) includes:

- *Current State of Army Stewardship:* presently on track, but experiencing diminishing returns, and insufficiently poised to meet future requirements.
- *Desired Future State:* supporting the installations' mission by providing secure, efficient, reliable, and sustainable energy and water services with effective and proficient management of commodities, facilities, and utilities in partnership with the surrounding communities.
- *Guiding Operational principles*: being holistic, responsible, progressive, and sustainable.
- *Primary Goals:* (1) modernizing infrastructure, (2) improving utility security and flexibility, and (3) increasing utility and building efficiency.
- *Gaps in Supporting Activities:* research and development, planning, programming, collaboration, review, and feedback
- *Efficiency Potential and Investment:* To meet the expected energy intensity reduction targets out to 2013, the Army has to save approximately 14 TBtu/yr of on-site energy. The barracks program will save about 0.9 TBtu/yr

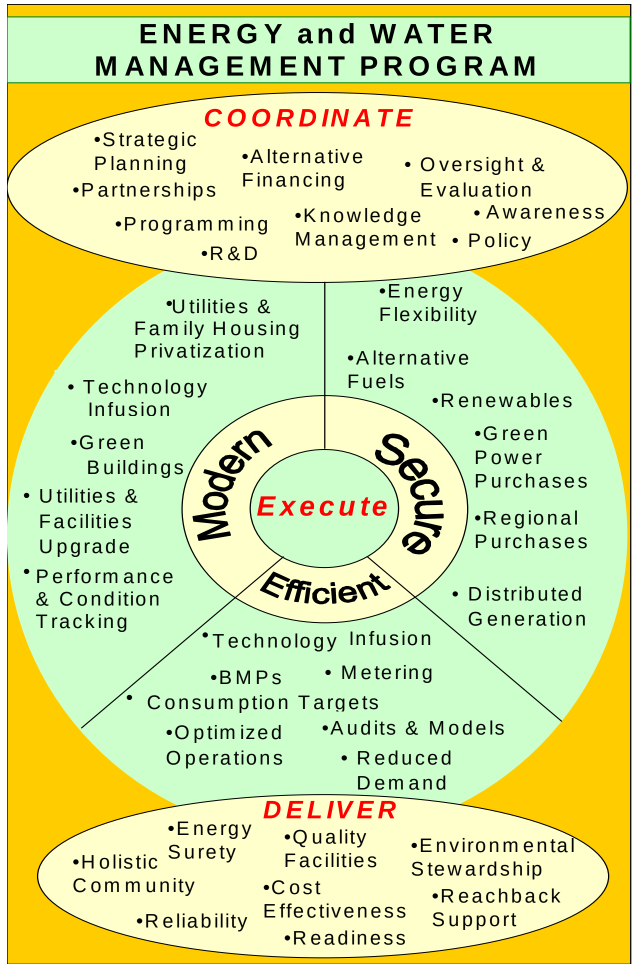

Figure ES1. Army energy and water program operational framework.

and the housing program will save about 1.5 TBtu/yr, leaving approximately 11-12 TBtu/yr to be saved in other programs and projects. A combination of energy efficiency, water efficiency, and renewable projects shows a potential energy savings near the required 11TBtu/yr. Enhanced energy savings from more efficient new construction and utility upgrades along with awareness activities will ensure a margin of safety in attaining goals. An estimated $1.7B investment in technology infusion Army wide would result in an ongoing saving of 11TBtu/yr of site energy (13.5 percent of current consumption), an additional 3.2TBtu/yr in source energy, 293MW of electrical demand, 10.8Bgal/yr of water (14.4 percent of current consumption), with a modified simple payback of 5 years, and a life cycle cost effectiveness. All of these represent true, self-compensating investments.

Operational Element: Coordinating Management and Technical Support

Aligned Programs: strategic planning, programming, policy, research and development, alternative financing; partnerships, awareness, knowledge management, oversight and evaluation.

Recommended Actions:

- Coordinate tiered national, regional, and installation level Long Range Energy Master Plans and Business Implementation Plans.
- Provide guidance on procedures, metrics, common yardstick calculations and updated software.

- Incorporate regional perspectives into strategic plans to most effectively meet Army-wide goals as an entire unit while not necessarily making the same progress at each installation.
- Fully fund the J Account at the installation level and institute the retained savings concept.
- Establish an Army Energy Steering Committee to help formulate policy, an Army Energy Technical Development Team to direct and support R&D efforts, and an Army Energy Technical Assistance Team to provide technical, strategic and tactical guidance for implementing the Program
- Expand partnerships with other DOD services
- Regular collaboration between OACSIM, IMA, Installations, the Corps of Engineers' centers of expertise, support, and research, the Defense Energy Support Center and the GSA is needed.
- Update guidance documents such as AR11-27, AR420-49, and the Energy Managers Handbook.
- Sponsor Regional installation energy manager forums sufficiently extensive to allow in-depth discussion and learning on experiences with implemented technology, funding strategies, and applicability to other locations.
- ACSIM and IMA should lead the requirements generation and prioritization of needed research, technology evaluations, and implementations. In addition, funding must be programmed for the full technology management cycle.
- Develop an expanded Centralized Knowledge Management System that combines existing databases, streamlines data retrieval options, increases on-line analysis capabilities, expands the breadth and depth of the knowledge base, and provides Army resource managers with the information and insight they need.
- Reduce data reporting gaps and inconsistencies in Army databases by linking reporting requirements to funding approval or shifting reporting requirements to utility providers, and provide immediate on-line feedback from the reporting system that flags suspect data and shows utility trends.
- Expand reporting to include annual trending analysis of utility flows, Energy Use Intensity, percentage of Water Best Management Practices Implemented, fuel portfolio, Green House Gas production, source energy and site energy impacts, HDD, CDD, population, industrial production counts, water and wastewater flows and costs, inches of precipitation and population counts.
- Periodically review if methods are producing the desired outcomes and whether the end states are appropriately defined.
- Display SPiRiT scores prominently on Showcase projects and register with the U.S. Green Building Council and rate according to LEED.

Operational Element: Program Execution

Goal: Modernize Infrastructure

Objectives: elevate facilities and utilities to modern standards of excellence, function, and reliability.

Rationale: increased effectiveness, quality of life, and efficiency while reducing overall utilities consumption.

Strategy:

- Rate and track facility condition and performance.
- Privatize most utilities and family housing.
- Upgrade utilities and facilities condition level.
- Infuse cost-effective efficiency technologies.
- Apply sustainable design and construction criteria.

Aligned Programs: Utilities and Family Housing Privatization, Technology Infusion, Green Buildings, Utilities and Facilities Upgrade, Performance and Condition Tracking.

Recommended Actions:

- Adopt USGBC's LEED for Existing Buildings or the EPA's ENERGY STAR® program (or both) for current buildings that are intended to remain in the inventory.
- Adopt E-Benchmark for new construction with intent of reducing energy consumption by 30 percent over standards practice.
- Update SPiRiT and merge closer to LEED or adopt LEED.
- Adopt the EPAct2003 proposed performance standard for new construction of 30 percent below ASHRAE 90.1-2001
- Develop and incorporate High Performance Building module designs into the Army's standard design library.
- Conduct investigations into energy performance rating protocols.

Goal: Improve Utility Security and Flexibility

Objectives: sustain energy and water services, enhance energy flexibility

Rationale: ensured availability of critical utility supplies.

Strategy:

- Reduce dependence on foreign energy sources.

- Increase multi-fuel options and on-site storage capabilities.
- Install renewable energy technologies and evolving distributed generation technologies.
- Regionally aggregate energy purchases.
- Obtain electricity from clean renewable sources.

Aligned Programs: Energy Flexibility, Alternative Fuels, Renewables, Green Power Purchases, Regional Purchases, Distributed Generation.

Recommended Actions:
- Establish a formal review process for Installation Energy Security Plans and develop an annotated template.
- Establish multiple electric feeders and substations at installations.
- Establish an enhanced renewable energy and fuel storage and diversity program.
- Central plants should have dual fuel capability or a back up fuel system.
- Incorporate distributed generation assets into new construction and central plants as technology becomes more cost effective and viable.
- Participate in purchases of green power.

Goal: Increase Utility and Building Efficiency

Objectives: meet energy conservation targets, use best management practices for water, and reduce coincident emissions.

Rationale: cost savings, increased comfort and occupant productivity.

Strategy:
- Monitor progress.
- Establish accountability.
- Prioritize technology infusion efforts.
- Systematically purchase efficient products.
- Employ technology to reduce electrical demand and optimize facility operations.

Aligned Programs: Technology Infusion, Best Management Practices, Consumption Targets, Metering, Audits and Models, Reduced Demand, Optimized Operations.

Recommended Actions:
- Decide to keep energy and water consumption from privatized housing in the energy accounting inventory.

- Where practical, meter all utilities at all buildings and at sub-building tenant level.
- Study and establish the best practice technologies for energy and water management and institute a buy-out (total replacement) program
- Incorporate commissioning and continuous commissioning of building systems.

Operational Element: Delivering Outcomes

Objectives: readiness, reach-back support, quality facilities, utility surety, cost-effectiveness, reliability, environmental stewardship, and holistic community.

Recommended Actions:

- Scrutinize third party financing methods and their associated economics.
- Disallow stipulated savings for ESPCs.
- Consider shared risk agreements on ESPCs, to reduce contingency costs.
- This framework should be reviewed by Army leadership, appropriately modified, and then adopted by the Army as a comprehensive energy and water management program.

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Units and Conversion Factors

A mix of U.S. standard units of measure and Standard International (SI) units are used throughout this report. Tables of conversion factors for SI units, unit prefixes, and examples of prefixed units used in this report are provided below. Of particular note, is the use of the SI prefix “k” with U.S. standard units such as in kBtu and ksf to mean thousand, and the use of the SI prefix “M” with U.S. standard units to mean million. These mixed units are common practice in the Federal energy community.

SI conversion factors		
1 in.	=	2.54 cm
1 ft	=	0.305 m
1 yd	=	0.9144 m
1 sq in.	=	6.452 cm^2
1 sq ft	=	0.093 m^2
1 sq yd	=	0.836 m^2
1 cu in.	=	16.39 cm^3
1 cu ft	=	0.028 m^3
1 cu yd	=	0.764 m^3
1 gal	=	3.78 L
1 lb	=	0.453 kg
1 kip	=	453 kg
1 psi	=	6.89 kPa
°F	=	(°C x 1.8) + 32
1 Btu	=	0.000948 J
1 Btu	=	2.931×10^{-4} kWh
1Btu/sec	=	1.055kW

Unit Prefixes				
U.S. Standard Prefix	**U.S. Symbol**	**Multiplication Factor**	**SI Prefix**	**SI Symbol**
thousand	M	10^3	kilo	k
million	MM	10^6	mega	M
billion	B	10^9	giga	G
trillion	T	10^{12}	tera	T

Examples of Prefixed Units Used in this Report		
1 kBtu	=	10^3 Btu
1 MBtu	=	10^6 Btu
1 BBtu	=	10^9 Btu
1 TBtu	=	10^{12} Btu
1 GWH	=	10^{12} watt-hrs
1 ksf	=	10^3sf

Non-SI* units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	0.00001638706	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	(5/9) x (°F – 32)	degrees Celsius
degrees Fahrenheit	(5/9) x (°F – 32) + 273.15.	kelvins
feet	0.3048	meters
gallons (U.S. liquid)	0.003785412	cubic meters
Horsepower (550 ft-lb force per second)	745.6999	watts
Inches	0.0254	meters
kips per square foot	47.88026	kilopascals
kips per square inch	6.894757	megapascals
miles (U.S. statute)	1.609347	kilometers
pounds (force)	4.448222	newtons
pounds (force) per square inch	0.006894757	megapascals
pounds (mass)	0.4535924	kilograms
square feet	0.09290304	square meters
square miles	2,589,998	square meters
tons (force)	8,896.443	newtons
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

*_Système International d'Unités_ ("International System of Measurement"), commonly known as the "metric system."

Preface

This study was conducted for the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers, under RDTE project 8BBFHG, "Army Energy Strategy" and as part of reimbursable projects 99604H and HJ484J for the Office of the Assistant Chief of Staff for Installation Management (OACSIM), for support of the Army Energy Program. The technical monitor for the overall strategy was Mr. Gary W. Schanche, Technical Director, Installation Operations, CEERD-CVT.

The work was performed by the Energy Branch (CF-E) of the Facility Division (CF), Construction Engineering Research Laboratory (CERL). Roch A. Ducey was the CERL Principal Investigator during FY02-03. Eileen T. Westervelt was the CERL Principal Investigator during FY04. Much of this work was done by Mr. Donald F. Fournier, of the University of Illinois Building Research Council, Urbana, IL under contract No. DACA88-99-D-0002-0017. The technical editor was William J. Wolfe, Information Technology Laboratory. Dr. Thomas Hartranft is Chief, CEERD_CF_E and L. Michael is Chief, CEERD-CF. The Director of CERL is Dr. Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL James R. Rowan, and the Director of ERDC is Dr. James R. Houston.

1 Introduction

Background

As the Army's flagships, installations are essential to the development and sustainment of operational capabilities and readiness to serve and protect the nation and its interests. To this end, installations must have robust, efficient, and well-operated facilities and utility systems. Since military installations are small cities with a full complement of facility types and utility requirements, they necessarily use significant amounts of energy and water. To secure its mission, the Army must competently manage these facilities and utility assets and their consumption of resources.

Managing these resources is a multi-faceted activity that must address diverse issues through a cohesive program. Such a broad program must meet operational mandates, review and update technologies, stay apprised of fuel and water outlooks, maintain a high level of security, assess environmental impact, examine consumption trends, work within corporate structures and financial constraints, and address facility condition and composition. Moreover, the overall program must undergo continuous review, evaluation, and refinement to remain relevant, responsible, and responsive to ever-changing circumstances, requirements, desires, and constraints.

Objective

The objective of this work is to develop a new candidate Army-level energy and water management strategy. This strategy will augment ongoing energy and water management initiatives within the Army by:

- responding to anticipated legislation
- reflecting current DOD and DA requirements, vision, and values in light of the current world situation
- incorporating sound science and management principles
- organizing and focusing ongoing efforts into an integrated program.

Approach

To accomplish the stated objective:

1. A focused review and distillation of applicable legislation, policy, guidance, documentation, programs, implementation procedures, and fuel and technology outlooks was conducted.
2. An engineering analysis was done of current resource consumption, technical efficiency potential, environmental impacts, and funding requirements.
3. Classical strategic planning techniques were applied to the existing management program to assess the current status of Army energy and water management, establish a vision of future potential, lay out guiding principles of operation and outline a method for delivering desired outcomes by coordinating management and technical support initiatives, setting goals, and organizing supporting objectives, strategies, programs, and actions.

The resulting plan summarizes the Army's overarching vision, objectives, and methods for energy and water resource management, and addresses critical actions, resources, and public/private partnerships necessary to meet the Army's operational requirements while maintaining security and quality of life for soldiers and their families and DA civilians.

Mode of Technology Transfer

Results of this work will be furnished to Headquarters, Engineer Research and Development Center (WHERDC) , the Office of the Assistant Chief of Staff for Installation Management (OACSIM), and the Installation Management Agency (IMA). It is anticipated that approved sections will be incorporated into the Army Energy and Water Master Plan.

This report will be made accessible through the World Wide Web (WWW) at URL:
http://www.cecer.army.mil

2 The Energy and Water Management Arena

Considerations

Change is a continuum in which the Army must operate as it transforms to the Future Force of the 21st Century. The energy and water management arena is no different. Changing mandates, technologies, fuel outlooks, and security issues form new challenges, and must be addressed. These challenges range from global issues (such as climate change and energy resource availability) to local issues (such as providing energy system security and meeting proposed new energy reduction targets). The management of Army energy and water requires synthesizing a complex set of drivers and circumstances into a unified strategy, including:

- *The National Energy Policy*, which seeks reliable, affordable, and environmentally sound energy for America's future by emphasizing the wise use of natural resources, expanding the national energy infrastructure, and increasing supplies while protecting the environment (National Energy Policy Development Group 2001)
- *The National Military Strategy*, which requires transformation of installation mission beyond deployment, to sustainment support of deployed elements and management of communities of excellence for the total force. This mandates a dual mission for installations—that of a warfighter enabler through power projection platforms and reach-back support hubs networked into battle space; and a partner in a holistic community of soldiers, their families, civilians, and contractors, crossing installation boundaries into the surrounding communities, mutually supporting for the common good (Joint Chiefs of Staff 2004)
- *Assorted legislation*:
  - National Energy Conservation Policy Act of 1978 (NECPA 1978).
  - Energy Policy Act of 1992 (EPAct92, U.S. Congress 1992).
  - Pending Energy Policy Act of 2003 (EPAct2003, U.S. Congress 2003). (Although the future of EPAct2003 is presently uncertain, the incorporation of its construction and operational requirements is strongly recommended to avoid the potential long-term mistake of building suboptimal facilities that are retained in the building inventory for an average 50+years, and to take a proactive— rather than a reactive and potentially short-

sighted—approach to resource management. The construction and operational provisions of the Act are reasonable and make good business and environmental sense. Thus, the pending legislation will be incorporated in this plan as though it were passed.

  - Various directives and mandates, e.g., Executive Order 13123 "Greening the Government Through Energy Efficient Management" [EO13123, Office of the Press Secretary, The White House 1999], which promote Federal leadership in energy and water management through efficiency, increased use of renewables, and fostering emerging technology markets; enhance energy conservation and research and development, and provide for security and diversity in the energy supply for the American people.

- *Guidance from multiple levels of Defense Components* (Department of Defense [DOD], Department of the Army [DA], Assistant Chief of Staff for Installation Management [ACSIM], Installation management Agency [IMA]), which includes a draft DOD Energy Management Framework and component level objectives (ACSIM 2004; IMA 2004; Brownlee 2004; Marrs 2002; OSD 2003; DA 2004).
- *Geopolitical realities* such as the distribution of natural resources, local and global impact of energy and water usage (global warming, acid rain, drought), current and potential military conflicts, and security threats (EIA 2004; Fournier 2002)
- *Existing national realities* including an aging utility infrastructure, limited congressional funding, partial regulation of energy sources, and the current state of the art of energy and water technologies (EIA 2004);
- *Existing Army Realities*, such as:
  - Current consumption trends. The Army is a large consumer of energy and water, of which about 80 percent of the energy and approximately half of the water is used for facilities conditioning and consumption (for heating, cooling, lighting, and hot and cold domestic water).
  - Existing corporate structures such as privatized housing, privatized utilities, existing long-term energy savings contracts; and the creation of the Installation Management Agency.
  - Facilities composition including substantial holdings of outdated infrastructure and facilities, and a dynamic facilities profile brought about by transformation and construction and renovation initiatives.

Insights

Although the list is far reaching, it is tractable. These combined realities form the basis for developing an understanding of the current status of the Army's energy

and water management programs, a vision of where we hope to be in the future, and a pathway for arriving at the desired end state.

This is a time of rapid change in the energy and utility industries. Over the next several decades, world and domestic trends will require considerable change in the way we conduct energy business within the nation as a whole and on Army installations, in particular. Utility deregulation, re-regulation, standard market reform, wholesale mergers and acquisitions, bankruptcies, and the collapse and recovery of the energy trading markets dominate the utility sector. Investments in the nation's electrical transmission infrastructure have not kept pace with load growth. Consequently, the addition of generating plant has lead to transmission difficulties in 28 states (NAS 2002). At the same time, the cost-effectiveness of new, renewable energy and distributed electrical generation technologies has the potential to fundamentally change the structure of national energy flows, especially at the local or regional level. Coincident with these external changes is a new business environment for military installations requiring privatization of many activities and functions, including utility systems. The technological and structural transformations will significantly alter energy sources and flows throughout the nation. This, combined with requirements for secure and reliable energy systems, has the potential to bring about major beneficial changes on military installations for sustainable management of energy resources.

The future does hold some certainty. Fossil fuels will continue to play an important role. Natural gas will be a preferred fuel due to its clean, efficient combustion and high domestic availability. Nationally and globally, the demand for fossil fuels and electricity will continue to grow. Current projections indicate that by 2025, worldwide energy demand will increase by 54 percent (EIA 2004). Environmental standards will increase and carbon emissions will be increasingly important. Technology will continue to advance, affecting all of the above.

The future also holds some uncertainties. The supply of oil, the production capability of natural gas, and the impacts of technology associated with these energy sources are unknowns. For instance, about one half of the recoverable natural gas supply in the world is considered "stranded" (too far from markets to be economically viable). This may change with the advent of on-site conversion of gas to liquids, which would, in turn, affect the out look for petroleum. Motor vehicle technology and fuel consumption have the potential to change radically for the better. The overall energy intensity of the economy, in terms of $/GDP (Gross Domestic Product), is trending down due to structural changes in the makeup of the GDP and energy efficiency gains, which have the potential to change much more rapidly than in the past. Ensuring reliable sources of petroleum and natural gas will become con-

tinually more problematic. We are becoming more reliant on imports from politically unstable areas of the world.

A strategy that can map the proper path for the Army's to meet its future energy needs must base itself on a knowledge of the certainties and uncertainties of energy situation, both domestically and throughout the world. Appendix A provides a more in-depth analysis of the world petroleum and natural gas situation.

3 Energy and Water Management Program Overview

Current Stewardship Status

To achieve its mission, the Army consumes significant quantities of energy and water. We understand our responsibility to lead by example in resource management and we continue to make substantial efficiency improvements and pollution reductions. We have met all current goals and targets and are confident of even greater success in the future as we build on our existing track record. We continue to be determined, disciplined, informed, and active.

However, there is widespread concern at the installation level that the obvious, quick payback means of increasing efficiency have already been implemented, and that new efforts are yielding diminishing returns. Further, financial resources are limited, source fuels are increasingly uncertain, and reduction and operational requirements are progressively more challenging. Energy Managers want and need more help to use limited dollars with as much impact as possible. The following sections summarize current consumption and emission trends, which quantifies "where we are" in terms of energy and water management.

Army Energy Trends

The Department of Defense (DOD) is the largest energy customer in the United States. With an annual facility bill around $2.4 billion dollars for the purchase of about 211 trillion Btu's (TBtu) of energy, improving the efficiency of defense buildings will reduce Federal resource requirements (FEMP 2002). The Army leads the DOD in real estate assets held with 900 million sq ft in 135,000 owned or leased buildings on 1,771 individual installations and sites scattered throughout the globe (HQDA 2003). The current annual facility energy bill is $769 million, for 80Tbtu, including $16.5 million for energy intensive facilities such as laboratories and industrial activities (Williams 2003). Additionally, the Army purchases $137 million worth of mobility fuels, mostly gasoline, diesel, and jet fuel. Though significant progress has been made in reducing overall energy use, the trend has been one of growing electrical energy intensity, on a per square foot basis, resulting from the infu-

sion of electronic and automation requirements and increased demand for comfort air-conditioning systems.

Currently, about 80 percent of the Army's energy use is in fixed facilities. The Army achieved a 30.3 percent energy reduction in energy use intensity for standard buildings and facilities from fiscal years (FY) 85-03. Figure 1 shows the glide path. This was accomplished by implementing a multifaceted approach that combined awareness, energy saving projects, and new building initiatives. A major investment of approximately $363 million under various direct funding programs such as the Energy Conservation and Investment Program (ECIP) and Operations and Maintenance, Army (OMA) is creating major energy savings. Significant funding has gone into maintenance projects that enhance energy performance while repairing facilities. In addition, the private sector has made an investment in excess of $620 million under the Energy Savings Performance Contracts (ESPC), Utility Energy Service Contracts (UESC), and Demand Side Management (DSM) programs.

Greenhouse gas emissions attributed to facility energy use have also shown a decline. Trends can be calculated using Army facility energy consumption data and U.S. average factors for gaseous emissions, both from site energy usage and purchased electricity. The current Federal greenhouse gas reduction goal is a 30 percent reduction by 2010 with 1990 as the base year. Of the six greenhouse gases defined in the Kyoto Protocol, only carbon dioxide is considered as resulting from building energy use and is tracked. Since this is based on total facility energy consumption, the Army has already met the 30 percent reduction goal for both site and source energy (Figure 2).

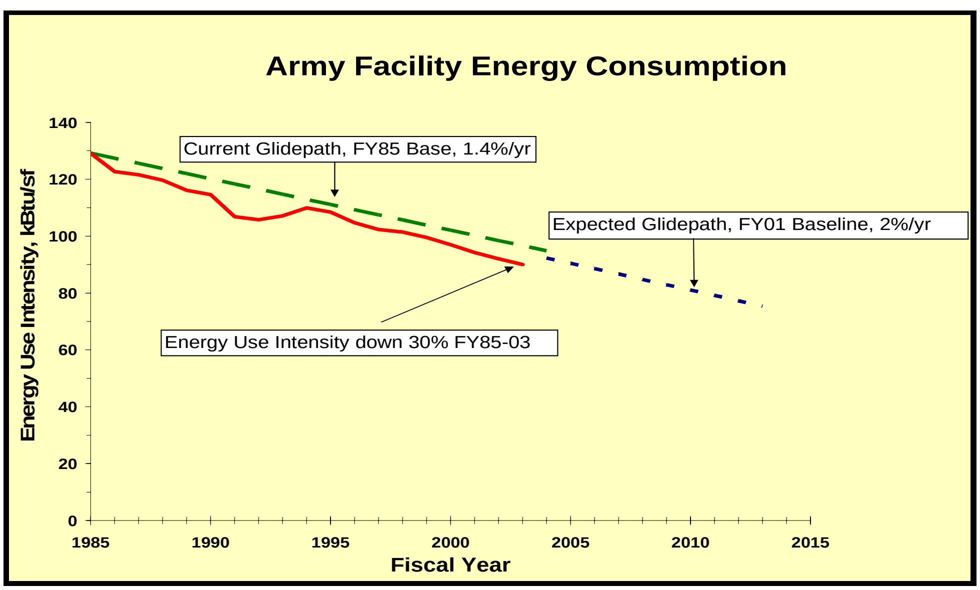

Figure 1. Army standard buildings/facilities energy glide.

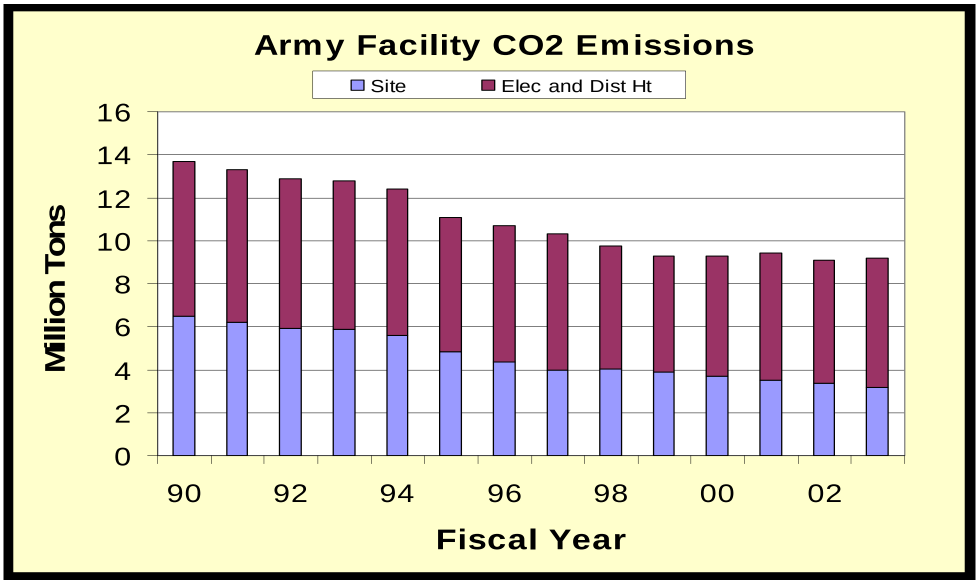

Figure 2. Army total facility CO_2 emissions.

There has been a steady decrease in the carbon emissions from energy use on installations. The electrical consumption of the Army has remained fairly steady since FY85 and the contribution from purchase electricity has fluctuated mainly due the generation mix on the grid. Over the last decade, the fossil fuel component has decreased, mainly due to increases in nuclear generation. Also, the Army has purchased progressively less district heat over the past decade due to facility closure. This has led to a small decline in source carbon dioxide. Overall, the Army's progress in carbon dioxide emission reductions have resulted from absolute reductions in energy consumption and a change in the types of energy used on installations.

Since 1985, the Army's site energy mix and total consumption have changed significantly. Figure 3 shows the trends from FY85 to FY03. The Army has greatly reduced its liquefied natural gas, petroleum, and coal usage while increasing its use of district heating and renewables. These changes have led to the significant reduction in CO_2 emissions noted above. Also evident is that electrical energy consumption has remained almost constant over the time period, indicating an increased electrical intensity on a per unit basis. This intensity increase is due to expansion in the use of information technology, personal appliances, and comfort cooling.

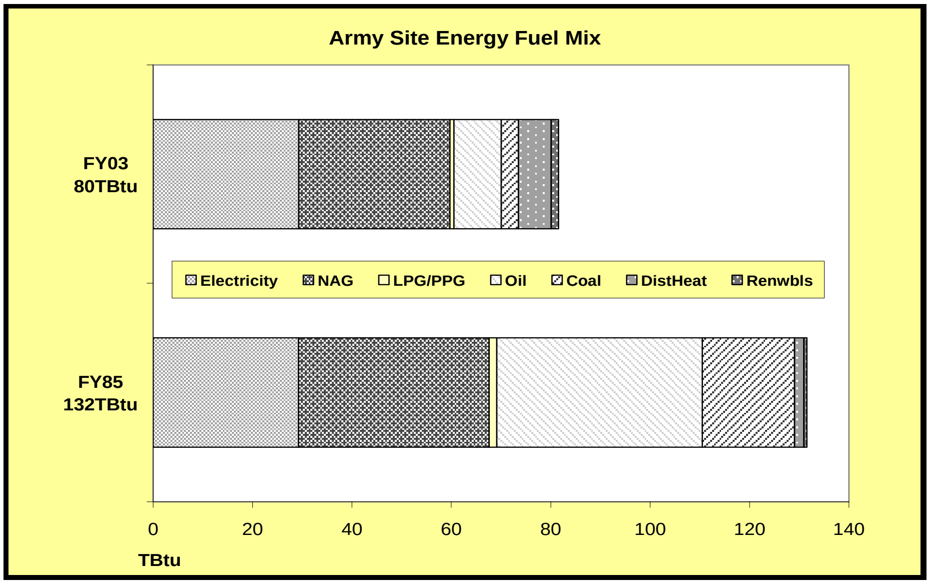

Figure 3. Army site fuel mix, FY85 and FY03.

Army Water Trends

In FY 2002, the Army consumed nearly 75 billion gallons of water at a cost of more than $125 million. Army water use has been steadily decreasing, but there is still a need to take steps to reduce the amount of water wasted on Army installations and to comply with the requirements of EO 13123. While water use dropped by almost 45 percent between FY92 and FY97, the cost of water service only decreased by 13 percent. This is because the unit cost of water has more than doubled. Similar trends exist for water disposal volumes and costs. In the same time period, water disposal volume dropped by 49 percent, while costs decreased by only 8 percent. This reflects a unit disposal cost increase of 80 percent. Greater treatment and testing requirements imposed on water suppliers by the Safe Drinking Water Act and amendments have increased the cost of providing potable drinking water. Additionally, some of those installations that purchase their water are increasingly likely to be on rate schedules designed to encourage conservation, such as increasing block rates or summer peak demand charges. Thus, water conservation efforts, in addition to being environmentally responsible, can help installations stretch O&M dollars. Also, those water conservation measures that also reduce wastewater quantities provide an additional opportunity for savings. Appendix B reviews the World and Domestic Water Situation.

Mission

As the Army continues to implement Transformation, installations are poised to meet their dual mission imperative:

- *As a Critical Warfighter Enabler*: to function as power projection platforms that provide effective training, rapidly mobilize and deploy the force, sustain and reconstitute the force; and as reach-back home base support to reduce the deployed footprint and,
- *As a Trusted Partner in a Holistic Community*: to fill a role as regional partners that provide for the well being of the Total Army—soldiers, families, civilian employees, and contractors—in concert with the local community.

This represents an expansion of the historical mission beyond deployment, to sustainment support of deployed elements, and management of communities of excellence for the total force. This also changes the view of installations as self-sufficient islands, to a vision where installations and communities are integrated and mutually supporting to leverage common infrastructure and services to create shared benefits, reduce duplication, and decrease operating costs. Furthermore, it is a recognition that the caliber of facilities and quality of life on installations must be brought to modern standards, so that, knowing their families are well cared for, soldiers and tactical units are better able to focus on their training, deployments, and operations. This acknowledges those soldiers and their families who live on and off the installation deserve the same quality of life as is afforded the society they are pledged to defend (ACSIM 2004; DA 2004).

Vision

This vision statement for the Army Energy and Water Management Program is a description of the desired future state, where we intend to be in the upcoming years. The Army envisions supporting the installations' mission relative to energy and water resources by providing secure, efficient, reliable, and sustainable energy and water services coupled with equitable, effective, and proficient management of commodities, facilities, and utilities in partnership with the surrounding communities. This will result in facilities and utilities and their management that are modern, secure, and efficient.

Accomplishing the vision requires addressing all facets of energy and water facilities, systems, and operations at each installation. Three primary goals underlie the vision and are to modernize infrastructure, assure utility security and flexibility, and improve utility and building efficiency. The Army can deliver the desired outcomes by coordinating management and technical support initiatives; organizing

objectives, strategies, and programs to achieve the goals; and maintaining suitable oversight, evaluation, and program adjustment.

The Army can reach its full stewardship potential by implementing all cost effective technologies and procuring, maintaining, and operating commodities, facilities and utilities to modern standards of excellence. To meet the requirements of the expected glide path out to 2013, the Army has to save approximately 14 TBtu/yr of on-site energy. This must be accomplished by a combination of greater efficiency in new buildings that replace existing buildings, raising the energy efficiency of existing buildings, and using on-site renewable energy. It is estimated that the barracks program will save about 0.9 TBtu/yr and the family housing program will save about 1.5 TBtu/yr, leaving approximately 11-12 TBtu/yr* to be saved in other programs and projects.

The estimate of the Army-wide potential for energy and water efficiency improvement and renewable energy potential that follows is based on an analysis with the Renewables and Energy Efficiency Planning (REEP) model (Westervelt 2003) and documentation on implemented projects. A combination of energy efficiency, water efficiency, and renewable projects shows a potential energy savings near the required 11TBtu/yr. Other energy savings from more efficient new construction and utility upgrades along with awareness activities will ensure a margin of safety in attaining these goals. The investment potential is based on a mix of alternatively financed and Army-funded projects. Where viable, the private sector was chosen as the financing vehicle. All projects include maintenance costs, as this is essential to reap the potential savings. Estimates of electrical load shifting projects and distributed generation/cogeneration potential are also reviewed. Appendix C includes details on modified economic metrics.

Substantial additional savings can be obtained with commissioning existing buildings. This recommissioning is the process of certifying that existing buildings are controlled and operated in a fashion appropriate for their current use (which may have changed several times since the building was constructed). This involves monitoring, testing, evaluating, and (if necessary) repairing or adapting all building conditioning equipment, software, and construction to ensure accurate, repeatable, and/or suitable function. Continuous commissioning involves dedicated trained staff, instrumentation, and ongoing computer analysis to maintain optimal opera-

* Calculations based on MILCON construction and renovation data from Barracks and FH Master Plans, HQRADDS data Dec 2002 and UIUC/BRC energy estimates.

tions. Continuous commissioning efforts have been shown to yield an average 20 percent savings in energy with an investment that pays back within 2 years. This continuous commissioning should be thoroughly tapped to accrue energy and cost savings and to increase comfort and productivity. This strategy must be used if further energy reductions are mandated (Culp 2000).

Energy Efficiency Potential

Table 1 lists the estimated potential saving of 8.1 TBtu/yr (10 percent of current consumption) with energy efficiency projects for an investment of $962M (assuming 80 percent of the projects are third party financed). Viable projects were selected based on life-cycle analysis and restricted to a 10-year modified payback (SPB*) or a bundled modified Savings-to-Investment Ratio (SIR*) greater than or equal to 1.0. Appendix D explains the modified economic metrics developed for this analysis in more detail.

Renewable Energy Potential

Renewable energy projects have not had significant impact because their paybacks are considerably longer than competing conventional technology. The capital costs tend to be high for the energy savings generated. Simply put, projects for renewables do not compete well when only face value economics are considered. However, when environmental impact, security, and sustainability are factored in, renewable projects are strong contenders.

Table 2 lists the estimated potential savings of 2.1 TBtu/yr (2.6 percent of current consumption) with renewable energy projects for an investment of $227M (assuming projects with SIR*>= 1 for third party financing are done out of house). Viable projects were selected based on life-cycle analysis and allowed a life cycle SPB* or a bundled SIR* greater than or equal to 1.0. Note that some projects were not viable for third party financing.

The Army will make special emphasis to fund renewable energy projects under ECIP and through DOE renewable energy funding programs. The Army will also use private financing to enhance the implementation of renewables. The use of private funding may also make the ESCO enhanced tax incentives and public benefit funding available to increase the viability of renewable energy projects.

Table 1. Energy efficiency investment potential.

	Energy Savings (TBtu/yr)	Demand Savings (MW)	Invest* Govt. Finc. ($M*)	Invest* Third Party FinC. ($M*)	Poll. Reduct. (Mton/yr)	Annual Savings ($M/yr)	SPB* (yrs)	SIR*- Govt. Finc.	SIR*- Third Party Finc.
Energy Efficiency Projects	**8.1**	**166.4**	**437.4**	**1093.4**	**1.0**	**88.5**	**4.9**	**2.5**	**1.0**
District Heating Repairs	1.6	0.0	6.9	17.4	0.10	7.6	0.9	17.1	6.8
Electrical Distribution	0.1	3.0	20.7	51.7	0.02	2.8	7.3	2.0	0.8
Lighting	1.1	92.0	109.5	273.7	0.28	24.1	4.5	2.6	1.0
HVAC-Controls	1.6	13.8	131.4	328.5	0.21	21.7	6.1	1.4	0.6
HVAC-Motors	0.3	17.8	27.5	68.6	0.07	5.0	5.5	2.6	1.1
HVAC-Htg and Clg Sys	2.1	17.6	93.4	233.5	0.20	16.8	5.6	1.6	0.7
Envelope	0.6	1.4	21.7	54.3	0.05	3.9	5.6	1.5	0.6
Domestic Hot Water	0.1	0.0	1.3	3.2	0.01	0.6	2.0	4.2	1.7
Miscellaneous	0.8	20.8	25.1	62.6	0.06	6.0	4.2	3.8	1.5

** Including Maintenance*

Table 3 lists the potential for water conservation projects in the Army based on a life-cycle analysis and restricted to a 10-year SPB*and a bundled SIR* greater than or equal to 1.25. It shows the potential for water saving projects is about 14 percent of present consumption with an investment of $194M (assuming 100 percent third party financing). An additional 0.5TBtu/yr also accompanies these projects due to reduced volumes of heated water and reduced pumping needs. These are specific technology applications and do not reflect all of the potential savings from instituting all of the Best Management Practices (BMPs) for Water (detailed in Appendix E), as some are not yet modeled.

Table 2. Renewable energy potential.

	Energy Savings (TBtu/yr)	Demand Savings (MW)	Invest* Govt. Finc. ($M*)	Invest* Third Party FinC. ($M*)	Poll. Reduct. (Mton/yr)	Annual Savings ($M/yr)	SPB* (yrs)	SIR*- Govt. Finc.	SIR*- Third Party Finc.
Renewable Energy Projects	**2.1**	**17.8**	**157.9**	**394.8**	**0.2**	**17.7**	**8.9**	**1.7**	**0.7**
Photovoltaic Arrays	0.1	2.1	28.1	70.2	0.02	3.1	9.1	1.7	0.7
Solar DHW	1.1	0.0	84.0	210.0	0.06	6.1	13.9	1.2	0.5
Solar Wall	0.5	0.0	13.9	34.8	0.04	2.3	6.1	7.0	2.8
Wind Turbines	0.5	15.7	31.9	79.8	0.12	6.2	5.1	2.9	1.1

** Including Maintenance*

Table 3. Water conservation project potential.

	Water Savings (Bgal/yr)	Energy Savings (TBtu/yr)	Invest.* Govt. Finc. ($M*)	Invest.* Third Party Finc. ($M*)	Poll. Reduct. (Mton/yr)	Annual Savings ($M/yr)	SPB* (yrs)	SIR*- Govt. Finc.	SIR*- Third Party Finc.
Water Efficiency Projects	**10.8**	**0.5**	**77.4**	**193.5**	**0.05**	**32.5**	**2.4**	**4.3**	**1.7**
Resource-Effic Washing Machines	0.9	0.5	28.3	70.7	0.04	6.1	4.7	1.8	0.7
Low Flow Toilets	3.4	0.0	15.5	38.7	0.001	13.5	1.1	7.5	3.0
Waterless Urinals	2.5	0.0	27.4	68.6	0.001	9.3	2.9	4.1	1.6
Water Distribution Leak Repair	4.0	0.0	6.2	15.5	0.005	3.6	1.7	8.5	3.4

** Including Maintenance*

Electrical Load Shifting Projects

Electrical load shifting projects are a class of projects aimed at reducing electrical demand charges, which is a significant proportion of installation electrical utility costs. These projects save money, but not necessarily energy. Thermal Energy Storage (TES) Projects and fuel switching projects are included in this group. TES applications reduce peak electrical demand by making ice or chilled water during nonpeak hours with electricity, then using the ice or chilled water for cooling purposes during peak hours instead of electric chillers. Fuel switching projects use a fuel other than electricity (usually natural gas) for engine driven application such as cooling, air compression, or water pumping. Fuel switching projects reduce source fuel consumption due to decreased conversion and transmission losses, but increase site fuel accounting. Electrical load shifting projects more than pay for themselves over their lifetime and can free up funds for other purposes. Furthermore, switching fuel needs away from electricity can increase security by decreasing dependence on the electrical grid and diversifying source fuels. The data listed in Table 4 indicate that an estimated 53MW of peak demand and 0.4TBut/yr of source energy requirements could be eliminated Army-wide with an investment of $51.3M (assuming 100 percent of the projects are government financed).

Distributed Generation Potential

Distributed generation (DG), the generation of electricity close to the point of use, is an appealing option for increasing power security. (Chapter 5 discusses the security aspect more fully.) Cogeneration is the simultaneous production of electricity and heat energy. Waste heat from power generation is captured and used for heating requirements for space heating or domestic hot water (DHW). The economics and performance of clean DG (which includes domestically fueled natural gas technologies and renewables) have improved significantly in the last 10-years. Turbines, engines, and fuel cells were evaluated for distributed generation/cogeneration at Army installations.

Table 4. Electrical load shifting potential.

	Demand Savings (MW)	Energy Savings Site (TBtu/yr)	Energy Savings Source (TBtu/yr)	Invest.* Govt. Finc. ($M*)	Invest.* Third Party Finc. ($M*)	Annual Savings ($M/yr)	SPB* (yrs)	SIR*- Govt. Finc.	SIR*- Third Party Finc.
Electrical Load Shifting Projects	**52.9**	**-1.0**	**0.4**	**51.3**	**128.3**	**8.0**	**6.4**	**2.1**	**0.8**
Thermal Energy Storage	21.1	0.0	0.0	13.8	34.6	2.6	5.3	2.2	0.9
Fuel Switching	31.9	-1.0	0.4	37.5	93.8	5.4	6.977	2.0	0.8

** Including Maintenance*

Table 5. Distributed generation/cogeneration potential.

	Elec. Gen. (TBtu/yr)	Demand Savings (MW)	Energy Savings Site (TBtu/yr)	Energy Savings Source** (TBtu/yr)	Invest* Govt. Finc. ($M*)	Invest* Third Party Finc. ($M*)	Poll. Reduct. (Mton/yr)	Annual Saving s ($M/yr)	SPB* (yrs)	SIR*- Govt. Finc.	SIR*- Third Party Finc.
Distributed Generation / Cogeneration	**1.6**	**56.3**	**-1.2**	**2.8**	**90.8**	**227.0**	**0.2**	**14.9**	**6.1**	**2.0**	**0.8**
DG/Cogeneration - Turbines	0.9	31.3	-0.7	1.5	25.0	62.5	0.13	3.7	6.8	2.0	0.8
DG/Cogeneration - Engines	0.7	25.0	-0.5	1.2	65.8	164.5	0.079	11.2	5.9	2.0	0.8

** Including Maintenance*

***source energy savings w/ thermal recovery credit*

The economics of turbines and engines are superior to those of fuel cells, and therefore included in the distributed generation/cogeneration potential listed in Table 5**.** Approximately 56MW of peak demand and 1.6TBtu/yr can be saved with an investment of $200M (assuming 80 percent third party financing). Although these projects are not life cycle cost effective with third party financing (i.e., they do not pay for themselves with their savings), the enhancements to security mentioned above make these projects worth considering.

Guiding Principles of Operation

Our program is guided by four fundamental ideals that keep us on course as we move steadily toward the full potential of modern, secure, and efficient facilities and utilities operated and maintained to today's standards. Our principles of operation, which were distilled from existing Army guidance, are being holistic, responsible, progressive, and sustainable.

- *Holistic*—Explore the full context, global view of impacts; look beyond face value economics; include review of sources and points of use, environmental impacts, productivity, quality of life, and safety; employ full life cycle cost analysis and source energy accounting.
- *Responsible*—Be mindful of the taxpayer; use resources (natural, monetary, and others) efficiently and thoughtfully; ensure sound stewardship in management of facilities and utilities; consolidate and streamline processes; form complementary partnerships and employ alternative financing to leverage combined resources and exploit regional economies.
- *Progressive*—Foster markets for emerging technologies by being early adopters; identify and support technology gap research and development; stay apprised of best business practices, dare to be innovative, bring multiple minds to bear on challenging problems, and make full use of information networking technology.
- *Sustainable*—Meet the needs of the present without compromising choices and standards of living for future generations—secure persistent, clean, and

affordable resources to maintain the mission while demanding systematic consideration of environmental impact, natural resources, economy, and quality of life.

Operational Elements

The Army Energy and Water Management Program methodology is comprised of three operational elements: (1) Coordinating Management and Technical Support Initiatives, (2) Executing a Program to achieve designated Goals with appropriate strategies; and (3) delivering the desired outcomes and assessing the adequacy of the arrived at state. Figure ES1 (p iv) graphically illustrates this method.

Coordinating Management and Technical Support

Coordination of Management and Technical Support entails strategic planning to meet policy objectives by interpreting information; incorporating research and development insights; supporting continuing technology gap endeavors; arranging appropriate financing; forming partnerships, maintaining awareness with training, media campaigns, awards and showcases; and implementing an execution plan with oversight and evaluation.

Executing the Program

Executing the Program consists of targeting three goals to make facilities, utilities and their operation Modern, Secure, and Efficient with supporting objectives, strategies, and programs. These goals are synergistic; total program implementation reinforces and enhances their effects.

- ***Modernize Infrastructure***
  The Army must elevate facilities and utilities to modern standards of excellence, function, and reliability to increase effectiveness, quality of life, and efficiency while reducing overall utilities consumption. It is recommended that the Army rate and track facility condition and performance, privatize most utilities and family housing, upgrade utilities and facilities condition level, infuse cost-effective efficiency technologies, and apply sustainable design and construction criteria.
- ***Improve Utility Security and Flexibility***
  The Army must sustain energy and water services to ensure availability of critical utility supplies. This requires enhancing energy flexibility by reducing our dependence on foreign energy sources; increasing multi-fuel options and on-site storage capabilities; and installing renewable energy technologies and evolving distributed generation technologies. The Army should region-

ally aggregate energy purchases and obtain electricity from clean renewable sources.

- ***Increase Utility and Building Efficiency and Reduce Demand***
  It is imperative that the Army continue to meet energy conservation targets, use best management practices for water, and reduce coincident emissions. A combination of metering, audits, and engineering models can monitor progress and prioritize technology infusion efforts. Systematic purchase of efficient products, employment of technologies and controls to reduce electrical demand, and optimization of facility operations will result in cost savings and increased comfort and occupant productivity.

Delivering Outcomes

Delivering outcomes from this comprehensive program will help the Army achieve its vision and goals for installation facilities and utilities well into the future. The dual mission for installations is accomplished through enabling readiness, providing reach-back support, and establishing quality communities. Utility security is achieved as cost-effectiveness, reliability, and sustainability are combined appropriately. Environmental stewardship is maintained and installations are integrated with local communities for mutual support.

4 Management and Technical Support Initiatives

Management and Technical Support Initiatives consist of strategic planning to meet policy objectives by interpreting information, incorporating research and development insights, supporting continuing technology gap endeavors, arranging appropriate financing, forming partnerships, maintaining awareness, and implementing an execution plan with oversight and evaluation. Coordinating these combined efforts—centrally—with regional approaches, definitive metrics, procedures, and feedback will yield effective teaming at all levels of the Army management structure, as information sharing, collaboration, and innovation are enhanced.

This centralization of management of the Army Energy and Water Program is a change from historical modes of operation where installations have managed their own efforts and where they were responsible for identifying, developing, and implementing projects, ensuring that new construction met sustainable design criteria, and maintaining awareness. Installations often lacked sufficient funding to delegate resource management to a full-time position. This resulted in necessarily hasty and piecemeal projects, inconsistent calculation methods, and lack of awareness of regional activities and opportunities. The creation of the Installation Management Agency with regional offices provides the needed orchestration component to comprehensively manage efforts on a regional and national level.

Traditional responsibilities and functions of Army elements implementing the program are outlined in AR 11-27 (HQDA 1997), Army Energy Program, and the DOD Energy Manager's Handbook (Carr 1996, Spain 1999). Both of these documents need updating to reflect current component groups, define goals and requirements, and institute formal tiered strategic planning and installation long-range energy management plans.

Energy and Water Program Management Structure

The key organizations and positions that provide the foundation for the Army energy program and their delegated responsibilities are listed below. The bedrock of the program is the installation energy manager. The efforts of the energy manager coalesce into the Army's effective program. Oversight and policy direction are pro-

vided in the various headquarter elements and work downward to the installations through the Installation Management Agency:

- *Senior Agency Official.* Principal Deputy Assistant Secretary of the Army (Installations and Environment) PDASA (I&E)—The PDASA (I&E) serves as the Special Assistant for Energy on the staff of the Secretary of the Army. The responsibility of the Special Assistant is to represent the Army on the Defense Energy Policy Council (DEPC), to implement tasks and initiatives from the DEPC, and to monitor the Army Energy Program.
- *Office of the Assistant Chief of Staff for Installation Management (OACSIM).* The OACSIM is the proponent for the Army Energy Program and is responsible for *policy, programming, and guidance.* The Utilities Privatization and Energy Team at the Facilities Policy Division of OACSIM provides installation policy guidance, develops resource requirements, maintains and manages energy and water data reporting, provides communications, and prioritizes and tracks Energy Conservation Investment Program (ECIP) projects.
- *Installation Management Agency (IMA).* The IMA is responsible for the implementation of the *Army Energy and Water Master Plan.* Overall program management and integration is achieved at the headquarters level. At the regional level, the IMA Regional Energy Managers are responsible for project implementation, energy goals progress tracking, and coordinating the day-to-day operational aspects of the energy and water management program within the region. This includes oversight of regional implementation and cross coordination of Installation Long Range Energy Management Plans.
- *Installation Energy Manager (EM).* Trained, professional energy managers in the field are the lifeblood of the energy and water management program. Responsibilities for energy management and conservation are identified in AR 11-27, Army Energy Management Program (HQDA 1997), and in the DOD Energy Manager's Handbook (Carr 1996, Spain 1999). The regional and installation energy coordinators are the focal point for energy-related activities. They develop the Installation Long Range Energy Management Plans, ensure program integration at the local level, and are responsible for tracking and reporting energy and water usage at the installation.
- *Resource Efficiency Manager (REM).* A REM can be a key part of the installation energy management team. Installations are encouraged to augment their energy management staff through the use of an REM. The REM is a contracted staff member dedicated to on-site activities related to energy and water conservation and overall utility cost savings. The activities of a REM can range from energy awareness to resource accounting to auditing to project review. REMs are designed to be self-funded, saving 200 to 400 percent of their annual salary. REMs are currently in place at Fort Lewis, WA, Fort Polk, LA, Fort Campbell, KY, Fort Benning, GA, and Redstone Arsenal, AL.

- *Building Energy Monitors (BEM).* Working with the installation energy coordinator are the Building Energy Monitors (BEMs). These individuals work or live on the installation and have been trained to keep a look out for appropriate operations at a single building or group of buildings. The BEMs are the eyes and ears in individual buildings, and the first level of quality control for building operations. They must be able to spot energy-related problems, fix, or submit work orders for corrections, and keep building occupants energy conscious. The coordinator has regular meetings with the BEMs to educate and provide them direction and feedback on the status of energy-related work orders. The DA Building Energy Monitor Handbook (CEHSC-P 1989) provides information on BEM responsibilities.
- *Army Energy Steering Committee (AESC).* This group needs to be re-established and chaired by OACSIM with representatives from IMA, Installation EMs and advisory input from the Army Energy Technical Assistance and Technical Development Teams and representatives from the other services to help OACSIM formulate Army Energy Policy and keep Army stakeholders informed on Tri-Service endeavors. Subject matter experts will provide technical expertise and recommendations on energy program subjects such as knowledge management, management framework, objectives, goals attainment progress, thrust areas, publicity, showcases and awards.
- *Army Energy Technical Development Team (AETDT).* This group needs to be re-established and chaired by OACSIM with representatives from HQIMA, USACE, IMA Regions, selected Installation EMs, and representatives from the other services. Its mission is to facilitate the requirements generation, options analysis, review, prioritization, proponency development and technology transfer of energy and water R&D performed by the various Corps laboratories.
- *Army Energy Technical Assistance Team (AETAT).* The Army should establish a virtual (cross geographical) Army Energy Technical Assistance Team whose core steering team includes representatives from OACSIM, HQ-IMA, IMA Regions, Installations, and HQ/U.S. Army Corps of Engineers (HQ/USACE), with advisory input from other organizations and agencies such as ERDC-CERL, U.S. Army Engineering and Support Center, Huntsville (HCX), DOE-FEMP, DOE National Laboratories, DESC, and the GSA as resources to provide technical, strategic and tactical guidance for implementing the comprehensive Army Energy and Water Management Program.

Policy

OACSIM is responsible for setting policy for the Army in the areas of energy and water management. This requires a synthesis of requirements, constraints, circum-

stances, and desires into cohesive guidelines for modes of operation. Many of the policy considerations are described in Chapter 2, "Army Energy and Water Management Arena" (p 3).

Strategic Planning

Strategic planning is the process of systematically laying out a description of the current state of affairs, the desired end state, and a scheme for achieving the called for outcomes. It includes distilling policy; formulating goals with underlying rationales; organizing supporting objectives, strategies, programs and actions; establishing guiding principles of operation; and setting up modes of evaluation and adjustment. This document forms the basis of a national level strategic plan for the Army. (Turner 2001)

Tiered Planning

A tiered level of strategic planning is recommended for the Army. Plans at the national, regional, and installation level should be created and coordinated such that neither the big picture of national analysis nor the individual circumstances of the installation level are lost. Information and ideas flow up, down, and across the management structure. This brings together multiple perspectives on a complex program and results in synergies in processes and outcomes.

Regional plans would start with rollups of installation plans, but would also add assessments and decisions made with regional perspectives, to most effectively meet Army-wide goals as an entire unit, even though each installation might not necessarily make the same progress. For example, it might be cost effective to construct large solar arrays in a sunny location such as Arizona that would result in great progress toward renewable implementation rates at that location, but prove futile in places with low insolation, such as Oregon. Doing what makes sense, where it is most appropriate, produces the soundest overall stewardship of energy and water for the Army. Strategic plans at the installation level should follow the long range energy management plan format, below. Similarity in content and format will facilitate rolled up plans.

Installation Level Long Range Energy Management Plans

Between FY04 and FY06, each major installation shall develop a Long Range Energy Management Plan (PNNL 2003) designed to lay out a roadmap of action, which achieves the energy and water management objectives. Appendix F gives a complete plan format. The plans will consist of the following sections:

1. Executive Summary
2. Introduction
3. Energy Management Policy
4. Energy Management Organization
5. Energy and Water Use and Cost Tracking Systems
6. Building Stock Information
7. Utilities Infrastructure and On-Site Generation
8. Energy and Water Projects/Retrofits and Renovations
9. New Construction, and Major Remodels and Renovations
10. Project Financing/Implementation/Resources/Budget Plan
11. Incentives, Awards and Awareness Programs
12. Training
13. Evaluation and Reporting
14. References.

Programming

Army and Installation Level Energy and Water Management Business Plans

Multi-level strategic planning is a necessary exercise that allows planners to review the big picture, account for multiple parameters, and steer overall efforts in the desired direction. The next level of detail in planning is referred to as "business plans." These plans break down the strategies, programs, and actions items that move us toward our goals of tasking, scheduling, stationing, and budgeting. Business Plans also need to be tiered at the national, regional, and installation level. They provide the implementation details necessary to bring about the desired outcomes. These business plans also outline the funding strategies and partnering opportunities. Therefore, these plans form the basis for resource requirements for manpower, money, and materiel and corresponding rationale and prioritization for future year Program Objective Memorandums (POMs) and budgeting requests to Congress.

Funding the Utilities Operation Account

The Army should fully fund the projected utilities operations account (the J account) for each installation to incentivize the program at the local level and allow for retained savings. This is a change from the traditional mode of underfunding this account such that cost savings resulting from efficiency efforts simply resulted in a reduced requirement to reprogram funds from other areas to honor this "must pay" account. It also allows installations to take advantage of retained energy saving

options discussed in this chapter in the section, "Funding and Financing Mechanisms" (p 36) IMA Regional energy managers should be involved with the budgeting process for the utility account and should validate the requirements for each installation in their region.

Research and Development

The Army needs to establish a technology management process for research and development applied to installation operations and energy use. Figure 4 shows a notional process of managing R&D for this purpose. This process incorporates upfront ACSIM/IMA requirements generation (and associated proponency) with technology options analysis. Only after this explicit user requirements documentation, advocacy development, and options analysis, should research proceed. Integral with the research are ERDC, industry, DOE, and partnerships with academia as well as agreements on technology transitions.

Figure 4 represents a traditional weapons system technology management process. The Army does not manage our installation research and technology development this way today; rather, there are a few, un-integrated pieces of this process in place. These include a small amount of direct appropriations-funded (6.2) applied technology development, some Congressionally-directed demonstration and validation of industry-sponsored technologies (6.3), and a few reimbursable-funded technology evaluations (6.6).

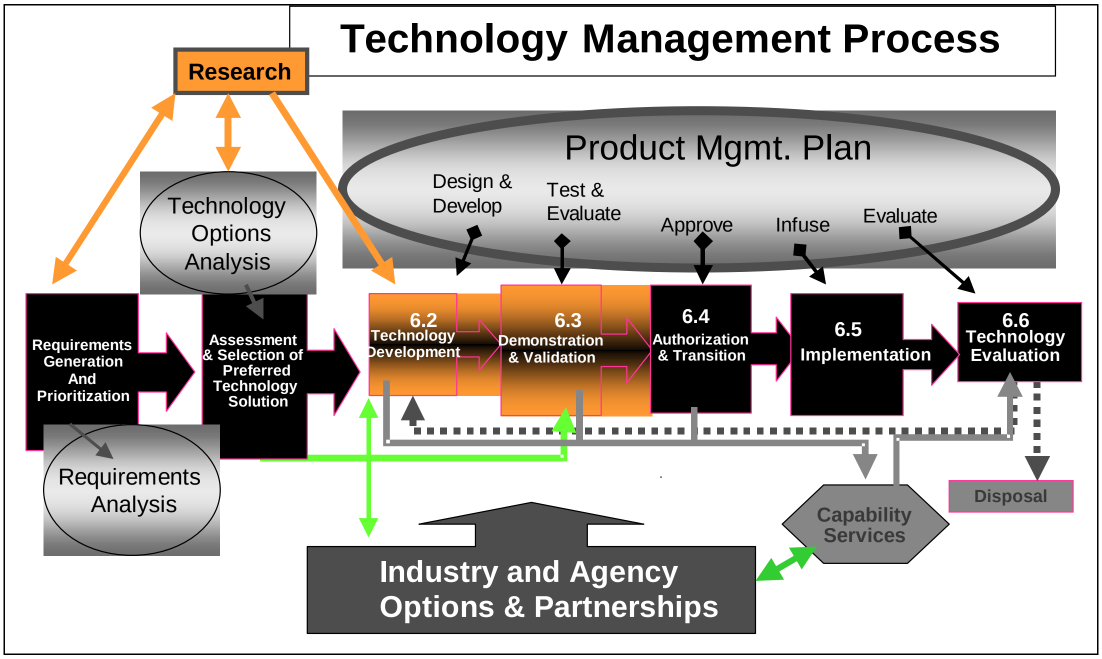

Figure 4. Technology management process.

None of the other pieces of the R&D management cycle are in place nor are they funded for a coherent, integrated infrastructure technology management plan. This type of deliberative process should incorporate the insights of installation and IMA master planning and ever-tightening energy and environmental legislation with input from the AETAT described elsewhere in this chapter.

For the Army to successfully demonstrate its commitment to providing for this kind of deliberate technology management planning and execution process:

- ACSIM and IMA must embrace the concept, and lead in the generation of requirements and prioritization of needed research, technology evaluations, and implementations with the establishment of the AETDT.
- Funding must be programmed for 6.2 (Applied Research), 6.3 (Demonstration and Validation), and 6.4/6.5 (Engineering and Deployment of new technologies).
- The technology management process must integrate with the traditional Army energy funding and financing mechanisms such as ECIP, ESPCs, and UESCs.

Army energy R&D should focus on the research, development, evaluation, and exploitation of energy technologies that improve energy efficiency and provide secure energy sources, to operate on a worldwide basis. This will include R&D that leads to:

- Sustainable building design and efficient operation of buildings and utility systems.
- A secure and sustainable energy supply through deployment of distributed energy and renewable energy systems.
- Efficient vehicles and equipment or modifications to the current inventory to reduce fuel consumption.
- Use of renewable energy sources and the development of cost-effective alternatives that reduce dependence on petroleum fuels.
- In-process reviews on proposed Army weapons systems, vehicles, and equipment, including an analysis of energy requirements. Energy used in development, production, and operation of the item will be evaluated, and the energy impact of alternative proposals will be considered.
- Effective energy management and analysis techniques.

Knowledge Management

The management of intellectual assets is vital to organizational productivity. It allows groups to do more with fewer resources, at a higher quality level and a faster pace. It exploits the collective experience of an institution to its best advantage.

The modes of knowledge management are varied and range from web-based knowledge repositories with threaded links, interactive web collaborations, message and discussion boards, expertise access tools, learning and tutoring applications, search and data mining tools, newsletters, and proactive e-mail notifications. Effective knowledge management allows staff to augment their own skill set with pertinent shared ideas and advice without experiencing information overload. (Santosus 2004).

The transforming Army requires more sophisticated means of generating value from its intellectual property and is planning upgrades of knowledge management in the Energy and Water Management Program.

The current primary web databases related to Army energy and water management are the Headquarters Redesigned Army DUERS Data System (HQRADDS), the Headquarters Executive Information System (HQEIS) and the Installation Status Report (ISR). Collectively, these sources are a wealth of information on building inventory and condition, and utility consumption and costs. However, gathering and processing the pertinent facts for overall trending and review can be cumbersome.

OACSIM is in process of an upgrade and enhancement to HQRADDS. In addition to improving the data entry features, supplementary capability will be added to more easily create reports and review data. Current plans are to add a new "Engineers Data Base" to HQRADDS that will archive installation infrastructure, energy, and water characteristics.

Building on this current HQRADDS expansion effort, the Army should develop an expanded Centralized Knowledge Management System accessed through an Army Energy and Water Management Portal, that would combine the above-mentioned existing databases, streamline data retrieval options, increase on-line analysis capabilities, expand the breadth of the knowledge base, and provide Army resource managers with the information and insight they need. System users would be able to make one stop to decipher the who (people), what (data and knowledge), why (objectives and rationales), where (locations), and how (strategies and technology) of energy and water management. Additional resources would include decision making tools, analysis methods, planning templates, organizational charts with points of contact, current national, regional, and installation level strategic and business plans, procedure and policy documents, utility providers and cost information, partnership development help, technology information, communities of practice, case study information, lessons learned, best practices, an up-to-date calendar of events, and links to support options across the Federal and private sector that related to the Army energy program.

This ambitious undertaking will take a substantial investment in time, money and personnel. However, failing to embrace the latest information technology options will eventually compromise the mission and will—in the long run—cost more.

Oversight and Evaluation

Resource Accounting

Metering

Historically, metering of utilities on Army installations has been minimal. Often electricity, gas, and water have been metered at one central service entrance on an installation to enable utilities to bill the installation as a single customer at a large user/industrial rate. Electric demand metering was accomplished at a single point to reduce demand charges by exploiting the demand diversity of the entire installation, as a means of averaging a peak demand reading. Electricity and steam produced on the installation at central plants was either not metered, or were only master metered, as no sub-billing took place. Furthermore, OSD guidance decreed that metering did not directly save energy and therefore could not be covered under direct-funded investment projects. Only major reimbursable customers were submetered. This process was adequate in a time when energy and water were inexpensive and the global impact of their use was not understood.

Now, as we desire to better understand and optimize our utility consumption and maximize comfort conditions in buildings, expanded metering is appropriate. Pending legislation that requires the metering of electrical service only at each building is described in Chapter 5, "Program Execution," in the section "Increase Utility and Building Efficiency" (p 52). However, it is recommended that all utility flows be metered at a building or tenant level. This will allow for identification of efficient facilities, inefficient facilities, and the signaling of compromised utility flows that require attention.

Life Cycle Costing (LCC)

DOD is required to use life cycle cost analysis (LCCA) for all energy and water project evaluations (Office of the Press Secretary, The White House 1999, FEMP 2003). LCCA is an economic method of project evaluation in which all costs arising from owning, operating, maintaining, and disposing of a project are considered. Costs and savings that occur over the life cycle of a project are adjusted to their present value based on the time of occurrence and the time value of money. Considering the full life cycle impact helps energy managers decide if a project should be done at all,

which alternative to select if multiple options exist, and how projects should be prioritized. The economically optimum alternative among technically equivalent options is the one with the lowest life cycle cost. LCCA is particularly pertinent to energy efficiency projects where higher first investment costs are offset by lower operations and maintenance costs for many years in the future.

Design and construction of new facilities is required to meet or exceed the energy performance standards set forth in 10 CFR 435 (DOE 1988), local building standards, or other specified limits, whichever resulted in the lowest life cycle cost. 10 CFR 436 (DOE 1996) spells out the requirements for selecting the most life-cycle effective course of action. Life cycle cost is to be minimized by using energy efficiency, water conservation, or solar and other renewable energy technologies. The use of passive solar design and active solar technologies is required where cost effective over the life of the project. In addition, a facility-commissioning program is required to ensure that construction of facilities meet the outlined requirements before the facility is accepted into the Army's inventory.

Source Energy Accounting

The Army seeks to reduce total energy use and associated greenhouse gas and other air emissions, as measured at the source of combustion.* To that end, installations shall undertake life-cycle cost effective projects in which source energy decreases, even if site energy† use increases. In such cases, those installations will receive credit toward energy reduction goals through guidelines developed by (DOE 2000). Each completed project where source energy use declines but site energy increases, both site and source energy impacts should be calculated for the reported fiscal year. Installation may use the national average source conversion factors used by DOE or may choose factors from the particular utility or steam provider. If an installation is using a conversion factor obtained from its utility, it should include each of these components and be properly documented. Guidance on source energy accounting should be distributed to all installation energy managers. Additional benefits and recognition of projects that reduce source energy are:

- *Impact on Greenhouse Gas Reduction Goal.*
  In measuring progress toward the new greenhouse gas reduction goal, greenhouse gas emission calculations will be based on source measured energy. Therefore, projects that result in source energy reductions will directly con-

* Source fuels for purchased electricity are fuels used for electric generation at the power plant.

† Site fuels are fuels used within the installation perimieter.

tribute to an installation's and the Army's performance toward the greenhouse gas reduction goals.

- *Reductions in Source Energy per Gross Square Foot.*
  Army progress toward energy reduction goals will be tracked in the *Annual Report to Congress on Federal Government Energy Management* on a source-measured basis as well as on a site measured basis. This highlights the Army's achievements in source energy reductions.

Reporting

Installations are required to submit energy data to HQRADDS monthly, real property data to HQRADDS and ISR annually, water use, and installation operations cost and condition information to HQEIS and ISR annually and rolled up utility information for the *Annual Report to Congress on Federal Government Energy Management.* Currently, reporting gaps and inconsistencies in the databases are common. Linking reporting requirements to funding approval or shifting reporting requirements to utility providers are two potential ways of better tracking utility flows. Furthermore, immediate on-line feedback from a reporting system that flags suspect data and shows utility trends, would help increase the likelihood of usable information.

Trending Analyses

The Installation Long Range Energy Management Plan Format calls for pertinent trending analysis of utility flows that should be updated on an annual basis: specifically, Energy Use Intensity, percentage of Best Management Practices (BMPs) implemented, changes in fuel portfolio, and Green House Gas (GHG) production.

Energy Use Intensity (EUI) on an installation-wide kBtu/sf/yr basis, compared to the mandated Army reduction glide path since FY85 to present, should be graphed relative to the FY85 base year and the anticipated FY01 base year to determine whether goals are being achieved, or at least if progress is being made over time. The EUI metric only addresses one primary determinant of energy consumption (building square footage) and ignores several others. Other key determinants of energy consumption are weather, mission and function, operating set points and schedules, occupation rates, degree of maintenance received, and construction vintage. Since so many factors affect the total consumption of buildings, variations in the glide path are expected. Therefore, additional parameters such as HDD, CDD, population, and industrial process counts should also be tracked to better understand deviations from the prescribed glide path. It is recommended that additional investigation into energy performance rating protocols be conducted to better assess the true performance of buildings.

Percentage of implemented Best Management Practices for Water Efficiency should be tracked over time along with water and wastewater flows and costs. Water management has a process versus consumption goal orientation where the application of appropriate technology retrofits and management methods are measured. This was chosen over the consumption measurement since water usage is quite variable from year to year as it is heavily dependant on irrigation needs. Additional parameters such as annual precipitation variations and population counts may also provide useful information, enabling a better understanding of annual water consumption rates.

Fuel portfolio breakouts (pie charts) of amounts of site and source energy by fuel type over time are necessary to track adequate diversity of fuels, movement toward cleaner fuels, and estimates of GHG emissions.

Feedback and Adjustments

The trending analysis described above will help determine progress toward goals and point to opportunities for adjustment and improvement. Periodic reviews to determine if methods are producing the desired outcomes and whether the end states are appropriately defined are necessary to reach the Army's full potential for stewardship of energy and water. Periodic third party review of the overall process at IMA and ACSIM with assistance from AETAT may generate unexpected and desirable solutions.

Awareness and Recognition

Training

The Army will increase emphasis on training at all levels within the energy program, especially at the installation level. A 40-hour course in energy management for existing facilities that meets the requirements of the Energy Policy Act of 1992 for trained Energy Managers is available through the Association of Energy Engineers, and the Army Corps of Engineers, Huntsville Engineering and Support Center (CEHNC). Energy managers are encouraged to become Certified Energy Managers (CEMs) by taking the course and passing the exam. (OACSIM will annually fund the registration and TDY for a limited number of installation energy managers to attend this course.) Also, DOE-FEMP offers a free 40-hour Energy Manager's Telecourse each spring, which also meets training requirements and combines interactive live broadcast (or videotapes) with web based reading, problem sets, and quizzes. An Army Energy Program Interactive compact disk (CD) was published in FY98. This is intended to serve as a resource for installation level energy coordina-

tors. The CD contains tools, ideas, examples, and information for use in implementing energy projects and other program initiatives. Classes in sustainable design for new buildings, such as SPiRiT and LEED are available commercially, through ERDC/CERL, or the U.S. Green Building Council (www.usgbc.org).

Awards and Recognition

Energy conservation awards are presented to individuals, organizations, and installations in recognition of their energy and water savings efforts. In addition to recognition, these awards also provide motivation for continued utility reduction achievements. The Army initiated the annual Secretary of the Army Energy and Water Conservation Awards program in 1976. This program recognizes key installations and energy managers for their achievements. The Army also participates in the DOE Federal Energy and Water Management Awards Program. Both of these programs will receive renewed emphasis to encourage broader participation and enhanced awareness.

Showcase Facilities

To highlight successful energy efficiency projects, the Army designates "exemplary new and existing facilities with significant public access and exposure as showcase facilities to highlight energy or water efficiency and renewable energy improvements." Starting in FY03, the Army will have 10 showcase projects. This will be increased by two projects each following year. The showcase program functions as a management strategy by assisting the Army in implementing the goals of EO 13123 (Office of the Press Secretary, The White House 1999). Showcase projects may receive assistance from the Federal Energy Management Program (FEMP) and have the advantage of partnering with other agencies, energy service companies, utilities, and national laboratories. Each showcase site will prominently display a plaque notifying visitors that the Government building they are entering uses energy and water, and taxpayer dollars, wisely.

Past Army showcase examples are:

- *Fort Carson Green Training Building, Fort Carson, CO.*
  This 2800 sq ft sustainable training facility incorporates natural daylighting and high-efficiency windows to reduce energy use for heating and cooling and a natural cooling cupola that eliminates the need for air-conditioning. The building was constructed with recycled content materials and has an exterior photovoltaic (PV) security light, PV walkway lights, low-flow and metered faucets, and xeriscaping.
- *Watervliet Arsenal, NY.*
  Buildings 19, 110, and 115. Ten proton exchange membrane fuel cells

(PEMFC) were installed at three sites within the arsenal. This cutting-edge technology is expected to save the site 37,488 kWh per year.

Showcase Projects underway are:

- Fort Benning Barracks Complex, Phase I
- Fort Bragg Barracks, Armistead
- Fort Campbell Barracks, Range Road
- Schofield Barracks, Barracks Complex, Foote Ave-C
- Fort Wainwright, Mission Support Training Facility
- Fort Detrick, Community Support Center
- Fort Campbell, Barracks Renewal, Phase II
- Schofield Barracks, Information System Facility
- Fort Gillem, Special Purpose Facility (2nd Recruiting Brigade Administrative Facility).

Representatives from the AESC (discussed earlier in this chapter) should meet each year to select future showcase projects. Each showcase project will have an analysis of its successful features and lessons learned will be placed on the Army Energy Portal. It is also recommended that each showcase project have its SPiRiT score prominently displayed and that the Army consider registering these projects with the U.S. Green Building Council, rated according to LEED.

New Technology Demonstration and Deployment

The Army is committed to deploying new cost-effective and highly efficient technologies at installations. Proven energy-, water-, and cost-saving generation and end-use technologies—that have been demonstrated and independently evaluated under programs such as the DOE/FEMP New Technology Introduction program or the ERDC/CERL microturbine and fuel cell programs*—will be identified and promoted for new and retrofit applications. For some technologies, the Army will partner with the private sector and other agencies to undertake demonstrations, evaluations, and to promote the use of these technologies.

Message Dissemination

Message dissemination programs are important in achieving and sustaining efficient and effective operations at the installation level. Awareness programs depu-

* See www.doefuelcell.com

tize all participants as aides to furthering the program objectives. Awareness programs use assorted media resources such as seminars, websites, posters, stickers, displays and newsletters to remind installation occupants of efficiency goals and actions they can take toward goals attainment. Seemingly small actions such as turning off lights, setting computer power options, unplugging transformers on unused equipment, reporting water or steam leaks, etc., add up to significant savings over time.

The Army is in the process of developing an Army Energy and Water Management web-site (http://hqda.energypolicy.pnl.gov) to contain comprehensive information for energy managers, program goals and requirements, and to serve as a knowledge management portal. An expanded Centralized Knowledge Management System is recommended and discussed earlier in this chapter under Knowledge Management.

Army Energy Awareness Seminars are conducted at installations to provide assistance to the installation staff in meeting their energy goals. These seminars usually begin with a "walk-around" installation audit to identify low cost/no cost opportunities, which save energy and water, and culminate in a lecture/working meeting to establish a plan for action. Each year, the Army will conduct a defined number of these workshops.

The Army normally conducts an Army Energy Forum in conjunction with the annual Energy Conference sponsored by the DOE, DOD and General Services Administration (GSA). The Army plans to encourage IMA Region-sponsored installation energy manager Forums. These forums represent an opportunity for installation energy managers within each Region to discuss and plan strategies for meeting energy and water management goals and to learn about projects successes, funding and financing opportunities, new and emerging technologies, and new approaches to energy and water management. It is recommended that these forums be sufficiently extensive to allow in-depth discussion and learning on experiences with implemented technology and applicability to other locations.

The Army also creates and distributes newsletters/updates on energy management programs. These include the Natural Gas Risk Management Newsletter and the Garrison Commander's Guides to Energy Management, Energy Savings Performance Contracting, and Utility Privatization.

In addition, to Army communications materials, DOE publishes a Monthly FEMP Update and regularly posts updates on energy-related legislation, utility energy services contracting news, water resource management, workshops, and other items of interest to the Federal sector on a FEMP web-based bulletin board. These communications materials will be linked from the Army Energy Program website. The

Centralized Knowledge Management System and the Training already described in this chapter are also powerful means of message dissemination.

Partnerships

Federal Sector Partnering

Partnerships with the other services are should be expanded as the DOD moves forward to a Joint Expeditionary Force. Inclusion of the representatives for the other services is recommended for the AETDT since the Army is the only defense group conducting installation R&D. This could benefit—and be supported by—all services. Furthermore, some Army R&D has been short on developing upfront proponency and could be enhanced by a larger user community. Tri-service representation is also recommended for the AESC as there is much to be gained from collaboration across services in terms of best practices, lessons learned, and specifics on defense application of technology and security ideas.

Regular collaboration within the Army family such as the Corps of Engineers' centers of expertise, support, and research; and with the Defense Energy Support Center (DESC); and the GSA is needed. These are resources for knowledge and cost sharing and leveraged buying power. (Regional purchases are addressed in Chapter 5, "Improve Utility Security and Flexibility" [p 46].)

DOE has numerous partnering opportunities available to the Army, which include the FEMP, the ENERGY STAR® Program, and the Bonneville Power Administration (BPA). These programs help Federal facility and energy managers achieve greater energy efficiency and cost-effectiveness in the areas of financing, engineering support, outreach, and policy review. FEMP also provides an avenue to access staff in the DOE National Laboratory system that is available to provide technical support on an as-requested basis.

Army Energy Technical Assistance Team (AETAT)

Interdisciplinary teaming, with an assortment of subject matter experts from pertinent fields, is becoming the widely accepted best management practice for synergistic and innovative solutions to challenging problems. Further, identifying and including all stakeholders from the start to finish of a project consistently yields higher team satisfaction and better outcomes. These stakeholders include customers (those who pay), consumers (those who use) and constituents (those who care) about a given project. The combined experience of the team gives a more holistic

understanding of the problem and higher likelihood of a solution appealing to all concerned (USACE 2002).

Embracing this method, DOD should establish a virtual (cross geographical) interdisciplinary Army Energy Technical Assistance Team (as outlined under the Program Management Structure earlier in this chapter) to provide technical, strategic and tactical review and guidance for implementing the comprehensive Army Energy and Water Management Program. This team should be pre-funded and available to installation on an "on-call" basis to provide needed expertise and assistance.

Local Community Partnering

The transforming Army paradigm supports installations' partnering with local communities to consolidate and streamline identical services and leverage infrastructure to create shared benefits and reduce operating costs. This requires installation master planners and energy managers to network with regional and city planners and develop joint agreements on maximizing the impact of their resource investments for reciprocal advantage. In some locations, surrounding communities provide medical, dependent education, recreational, energy, or emergency services for installations. In other cases, both civilian and military communities augment each other's capabilities. Partnering with serving utilities is also encouraged for the development of nearby power generating assets and privatization of utility systems. In addition, relationships with higher academic institutions often provide sharing of facilities, knowledge, and personnel to everyone's benefit.

Private Sector Partnering

Partnering with the private sector is a means of sharing costs and benefits on energy and water projects even beyond the communities situated near installations. Many arrangements are set up where the private sector finances a utility efficiency work unit and is paid from resultant savings. (Details on these endeavors, such as ESPCs, are given later in this chapter in the section on funding and financing mechanisms.) Other partnerships allow for demonstrations of emerging technologies where companies provide equipment and services in exchange for demonstration sites, evaluation data and publicity. Still other partnerships involve joint venture development of products and systems to leverage personnel resources and bring multiple minds to bear on challenging issues with resultant joint benefit. Furthermore, assorted understandings have been established to provide continued maintenance and support of technical systems. Creativity and integrity are the key ingredients needed by all parties to create win-win partnering opportunities.

Funding and Financing Mechanisms

The Army has two primary options for funding energy efficiency, water conservation, waste water treatment, and renewable energy projects in buildings and facilities: direct appropriated (Federal) funding and private sector funding. Direct appropriation programs are the Energy Conservation Investment Program (ECIP), Operations and Maintenance Army (OMA) funding, and congressional appropriations for specific projects. Options that use non-Federal government sources of funding are energy saving performance contracts (ESPC), utility energy services contracts (UESC), and enhanced use leasing (EUL). Non-Government sources of funding can be used to supplement Government funding. Each of these three alternative sources can be combined with another.

Alternative Financing is the term used to describe projects not using direct appropriations. Simply put, self-compensating projects executed on Army installations are financed by the private sector. Alternative financing has been an option for years, but has become more important as traditional energy project funding sources have been reduced or eliminated. The Army intends to use alternative financing as the keystone of the energy program and maximum use of these financing strategies is required at all levels of project implementation and construction.

Since 1990, the Army has invested approximately $830 million in energy efficiency, $350 million of which was direct appropriations and $480 million from alternative financing mechanisms ($409 million from ESPC and $71 million from UESC and DSM[*]).

Direct Funding

Energy Conservation Investment Program (ECIP)

ECIP is a DOD level program funded under military construction for energy projects over $500,000. ECIP funds financed $87 million in energy projects from FY91 through FY99. The Army's portion of the ECIP program is centrally managed by the ACSIM. The level of funding varies from year to year and some recent years have been zeroed out. The Army's portion has typically been around $10-13 million/year.

[*] Based on Spreadsheet from Mike Kishiyoma, CEHND, October 2002.

Qualifying projects must achieve a specified simple payback and SIR as well as compete with other qualifying projects for funding. Guidance for the ECIP program is provided each year from the ACSIM. The Army's ECIP funding is directed toward projects that result directly in energy savings and cost reduction by improving the energy efficiency of existing Army facilities or constructing new, high efficiency energy systems. Realized savings should be auditable and the initial submission on the DD 1391s of proposed projects shall identify the method to be used for savings verification. Guidance on savings verification is available in the FEMP Measurement and Verification Guideline for Federal Energy Projects and the International Performance Measurement and Verification Protocol (located at www.ipmvp.org). Projects will be selected based on several criteria, not just energy savings, but also on meeting other pertinent program goals such as renewable energy targets.

Operation and Maintenance Army (OMA)

The other major source of funding for energy projects comes from the Army's regular operation and maintenance funds. As facilities are repaired and upgraded to present standards, significant savings can be obtained from cost-effective additions to the projects that target energy efficiency and water savings. A basic rule of thumb is that every project should be considered an energy project and opportunities to save energy and water maximized in the design and implementation of repairs and replacements.

Retention of Energy Savings

With the full projected requirements of the utilities operation account funded, pending EPAct2003 allows an installation to retain appropriated funds for energy expenditures, water expenditures, or wastewater treatment expenditures that are saved due to water and energy saving activities. Except as otherwise prohibited by law, these fund savings may only be used for energy efficiency, water conservation, or unconventional/renewable energy resources projects. This retention of savings is being used in the REM programs and needs to be implemented Army-wide.

Directed Congressional Funding

In some instances the U.S. Congress has appropriated funding to draw a market pull for evolving or underused technologies such as hydrogen fuel cells, hybrid vehicles, and clean coal technologies. Subsidies or grants may be available to implement particular projects that result in energy, environmental, or security benefits.

Private Sector Funding

Energy Saving Performance Contracts (ESPCs)

Energy Saving Performance Contracting is a process by which contractors audit Federal facilities, propose energy saving retrofits, and privately finance, install, operate, and maintain retrofits. The term energy savings means a reduction in the cost of energy, water, or wastewater treatment, from a base cost established through a methodology set forth in the contract, used in an existing facility and resulting from:

- The lease or purchase of operating equipment improvements, altered operation and maintenance, or technical services
- The increased efficient use of existing energy sources by cogeneration or heat recovery
- The increased efficient use of existing water sources in either interior or exterior applications.

Contractors are paid by receiving a portion of the cost savings realized through reduced energy or water consumption due to the retrofit. Remaining savings are returned to taxpayers and the agency. Executive Order 13123 further encourages use of ESPC as a means of alternative financing. The Department of Energy's Federal Energy Management Program (FEMP) has developed model procurement documents; the Measurement and Verification Guideline for Federal Energy Projects; a how-to manual for ESPCs; a home page on the internet; and educational videos for management, legal, and contracting personnel.

The use of ESPCs has been simplified by the availability of existing contracting vehicles through DOE, HCX, and DESC. DOE has awarded Super ESPC contracts covering its six geographic regions and three Technology Specific ESPC contracts. These contracts are available to all government agencies as a vehicle for using ESPCs and their use is encouraged.

Utility Energy Service Contracts (UESCs)

There are two types of regulated utility financial support available to the Army. The first is Demand Side Management Programs. Though widespread in the early 1990s, these programs have dwindled in a utility environment dominated by deregulation and market transformation. Where still available, installations shall consider this option in their financing mix.

The second type of financial assistance available is energy service contracting. Federal agencies are encouraged to participate in utility incentive programs. These

programs range from rebates on a piece of equipment all the way to delivering a complete turnkey project. Services provided for a project can range anywhere from auditing to installation and commissioning, including financing the entire project. Utilities may cover the capital costs of the project in consideration of the energy savings the retrofits will produce. In this arrangement, the net cost to the Army remains minimal, and the Army saves time and resources by using the "one-stop shopping" provided by the utility. Utilities are one source for financing energy projects. The Army Corps of Engineers Huntsville Engineering and Support Center provides help to facility personnel in selecting the most appropriate utility contracting vehicle and putting a contract in place. Maximum use of this contracting method is encouraged as it can be more cost effective than ESPCs and amortize over a shorter time span.

Bonneville Power Administration (BPA) Financing

BPA financing is available to any Federal agency and is classified as "other" 3rd party financing. Army installations can enter into an agreement with BPA to receive nonappropriated private-financial market financing through BPA. The authorizing legislation for receipt of BPA funding by Federal installations can be found in 10 USC 2865 "Energy Savings at Military Installations," EPAct 1992, Federal Acquisition Regulation (FAR) Part 41 "Acquisition of Utility Services," and 40 USC 501 "Federal Property and Administrative Services Act." The installation can then choose a qualified contractor to implement the project, which may be the servicing utility accessed under the authority given for UESC.

Enhanced Use Leasing (EUL)

Enhanced Use Leasing is part of a legislative authorization for military departments to lease underused real property, governed by Section 2667 Title 10 United States Code. The term "enhanced" was added as part of a 2001 amendment from Section 2812 of H.R. 5408, the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 and enacted into Public Law 106-398. The major changes made in this amendment expand the categories of consideration received in exchange for a lease as well as expanding the potential properties for which the consideration can be used.

The new law requires the lessee to pay, in cash or in-kind, consideration in an amount that is not less than the fair market value of the lease interest. However the categories of in-kind consideration that may be accepted in lieu of cash are expanded to include construction of new facilities, restoration (including environmental), acquisition, alteration, and other services. Furthermore, the Army may

now accept in-kind consideration for any property or facility under its control, rather than just at the installation where the property was leased. Cash consideration is now available for an expanded variety of base operating support functions including construction or acquisition of new facilities, restoration (including environmental), lease of facilities, facilities operation support, improvement, alteration, and other services (USMA 2002; Weinhold 2002). Improvements in energy efficiency and the installation and operation of cogeneration facilities also fall under this umbrella of in-kind payments.

The law specifies that cash proceeds received from leases, easements, or temporary use of real property will be shared "50-50" by the installation where the property is located and the military department. The money must be used for the following: (1) maintenance, protection, alteration, repair, improvement, or restoration (including environmental restoration) of property or facilities, (2) construction or acquisition of new facilities, (3) lease of facilities, and (4) facilities operation support. The Army may not expend more than $500,000 at a single installation until 30 days after reporting to Congressional Defense Committees on the proposed expenditure.

Money rentals received from leases, easements, or temporary use must be deposited into a special Treasury Account. Payments for utilities or services furnished to lessees under such leases may be deposited to the credit of the appropriation from which the cost of providing them was paid.

Over the past years, DA has distributed the majority of the Headquarters, DA share to the parent MACOMs of the generating installations. However, in some cases, the military department has used its authority to apply these funds for Army-wide facility maintenance and repair and environmental restoration requirements. DA should now continue the practice of distributing the majority of the funding to the parent IMA Region of earning installations unless they determine that there are other higher priority requirements for the funding.

5 Program Execution

Modernize Infrastructure:

The Army must elevate facilities and utilities to modern standards of excellence, function and reliability to increase effectiveness, quality of life, and efficiency while reducing overall utilities consumption. It is recommended that the Army rate and track facility condition and performance, privatize most utilities and family housing, and upgrade government held utilities and facilities to C2 condition level* by retrofit or replacement, by infusing cost effective efficiency technologies, and by applying green design and construction criteria in both new construction and OMA-funded projects.

Upgrade Utilities and Facilities

Utility Systems

Utilities Privatization. Utilities privatization is the preferred method for modernizing and recapitalizing Army utility systems. This allows installations to focus on core defense missions and functions instead of the responsibilities of utility ownership. Installations will benefit from innovative industry practices, the reliability of systems kept at current industry standards, and private sector financing and efficiencies. The Army will complete privatization decisions on all electric, water, wastewater, and natural gas systems by 30 September 2005. Except where the Secretary of the Army has certified that the systems are exempt due to security reasons or where privatization is uneconomical, the Army will privatize those types of utility systems at every Active, Reserve, and National Guard installation, within the United States and overseas that is not designated for closure under a base closure law. Since upgrades are normally completed within 5 years after a privatization award is made, all privatized systems should reach a readiness level of at least C-2

* Facility condition code on a scale of 1-4, with 1 being the best condition. C-2: supports the majority of assigned missions-meets 80-95 percent of requirement. "Defense Planning Guidance for the 2004 – 2009 Fiscal Years" Office of the Secretary of Defense, May 10, 2002.

prior to 2010. The Army should program sufficient funds to support privatization contracts.

Legacy Utility Systems. Installations will establish and maintain C-2 level for utility systems that are not privatized. Under current Defense Planning Guidance, the Army is directed to achieve a 67-year recapitalization and sustainment rate in which the readiness of existing facilities is restored to a C-2 status, on average, by the end of FY 2010. The Army should program sufficient funds to accomplish this guidance.

New Building Performance Standards and Ratings

Congress intends to amend The Energy Conservation and Protection Act (ECPA), in proposed Energy Policy Act of 2003 (U. S. Congress 2003) by mandating that new Federal buildings contain energy saving and renewable energy specifications that exceed the energy saving and renewable energy specifications of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) / Illuminating Engineering Society of North America (IESNA) Standard 90.1-2001, "Energy Standard for Buildings Except Low-Rise Residential Buildings," or the Council of American Building Officials International Energy Conservation Code (IECC) 2003 for residential buildings. It is proposed that energy performance standards for new construction be 30 percent below the prescriptive standards of ASHRAE 90.1-2001 for commercial buildings, or 30 percent below the International Energy Conservation Code for new residential buildings. The Army should embrace this concept whether or not it becomes law.

Use of *The Energy Benchmark (E Benchmark) for High Performance Buildings, Version 1.0*, by the New Buildings Institute (www.newbuildings.org), is recommended as a design guide for constructing nonresidential buildings to the new energy standards (Johnson, Cowan et al. 2003). Adoption of the Home Energy Rating System (HERS) using the Normalized Modified Loads Method and attaining a score of 89 or better is recommended for Family Housing construction (www.resnet.org).

Focused Facilities High Performance Designs

As part of the force structure realignment via the Unit of Action Modularity concept, the Army is developing a facilities design strategy focused on key building types that are prevalent in the building inventory. Initially, Tactical Equipment Maintenance Facilities (TEMF) will be the first type of facility to undergo review for standard design potential leading to high performance facilities. Ten functional elements will be accommodated in the future TEMFs. Other building types and sys-

tems will follow. These high performance building module designs, which incorporate energy efficiency features according to function, climate, and utility pricing structures, should influence recognized best design practices and be incorporated into the Army's standard design library.

Existing Building Performance Standards

The Army will modernize its existing building stock to a standard that meets ENERGY STAR® Buildings℠ criteria. ENERGY STAR® Buildings℠ is a program developed by the USEPA and DOE to promote energy efficiency in buildings. ENERGY STAR® Building℠ certification and labeling is based on measured building data and a comparison with archetypes in various regions of the country. Army buildings are not generally metered and temporary metering schemes are cost prohibitive. Therefore, until the Army Building Metering Program is fully implemented, the installation may self-certify and develop a local label for nonmetered buildings based on the knowledge of what retrofits and no cost/low cost options have been completed in those buildings (EPA 2004). Once metered data is available, the installation will use that data to input the benchmarking software program available on the EPA web site to certify the buildings against criteria and label accordingly. It is recommended that all existing building be brought into the upper 25th percentile of energy performance by 2015. This should be accomplished by focusing OMA projects towards energy efficiency—simple replacement in kind of energy related systems is not allowed without a formal analysis of its impact on energy performance and how the project will improve energy efficiency. Repairs and replacements will enhance energy posture and performance.

Tracking of facility condition and performance

The Installation Status Report (ISR) is the primary vehicle for tracking the Army's progress in upgrading its buildings, facilities, and utility systems to C2 status. Progress will be reviewed annually, and funding priorities will be established to focus funding on the most important areas.

Housing Programs

Army Family Housing Master Plan (AFHMP). The AFH Master Plan (AFHMP) provides a centralized Army-wide master plan for programming and execution of the AFH Program (ACSIM 2004). The family housing revitalization goals are accomplished through a combination of traditional Military Construction (MILCON / AFHC) and privatization / Residential Communities Initiative (RCI). The current plan expands privatization in CONUS and includes improvements to existing housing through traditional MILCON.

The Whole Neighborhood Revitalization initiative projects are based on lifecycle economic analyses and support the OSD goal of funding the elimination of inadequate housing by 2007. AFHC funded projects focus on the restoration and modernization components of the Army's Sustainment, Restoration, and Modernization (SRM) program. The AFHC program includes:

- New construction of 1,358 units
- Improvements (Revitalization): 1,162 units
- Scoring and direct investment in support of privatization for 12,000 units.

The AFHMP plans to transfer 34 installations to Residential Community Initiative (RCI) partners by FY07. Additional installations continue to be evaluated for privatization that would expand the program to 45 installations (95 percent of the government owned AFH in CONUS). RCI leverages appropriated funds and government assets by entering into long-term partnerships with nationally recognized private sector real estate development and management firms to obtain financing and management expertise to construct, repair, maintain, and operate family housing communities. The Army has also implemented a Portfolio and Asset Management Program to monitor implementation of RCI plans and financial health of these multi-billion dollar 50 year agreements.

Restoration and Modernization are the other two components supporting recapitalization. Restoration includes repair and restoration of facilities damaged by inadequate sustainment, excessive age, natural disaster, fire, accident, or other causes. Modernization includes alteration or modernization of facilities solely to implement new or higher standards, including regulatory changes, to accommodate new functions, or to replace building components that typically last more than 50 years, such as foundations and structural members. The Army continues to eliminate excess facilities to allow us to use resources where they have the most impact. The AFH demolition program will continue to eliminate unneeded units.

The RCI will have significant impact on the Army's energy glide path. Family Housing accounts for about 16 percent of the Army's energy consumption and is the least consumptive square footage in the inventory. If the privatized housing is removed from the inventory and energy accounting system, the Army's total performance metric (kBtu/sf) will increase by about 6-7 percent in a few short years, possibly causing the Army to be above the glide path. This makes efficiency improvements in the remaining building stock and in new construction even more of an imperative. If the privatized housing is kept in the inventory, then it has the potential to positively impact the glide path as new and revitalized housing reduces current consumption. The potential is in the order to 1 to 1.5 TBtu/yr, which would lower the metric by about 2 percent over time. It is recommended that the FH energy consumption be kept in the energy accounting for the Army so the installation

does not lose track of this portion of its consumption, and that RCI contracts require ENERGY STAR® performance to ensure that FH energy consumption is efficient.

Army Barracks Program. Modernization of barracks to house permanent party soldiers is the Army's highest priority in the Military Construction, Army (MCA) appropriation. MCA provides the majority of funds used for major construction projects, augmented by Operation and Maintenance (OMA), Host Nation Support funds and supplemented in the past by Congressionally added Quality of Life Enhancement, Defense (QOLE,D) funds.

Many of the Army's VOLAR-type barracks (built from 1975 to 1985) and some atypical barracks buildings can be modernized under the Barracks Upgrade Program (BUP) using OMA funds instead of renovation or replacement under the MCA-funded Barracks Modernization Program. Overseas, a combination of Host Nation and U.S. appropriated funds are being used to bring existing barracks up to current standard and to eliminate any deficit. The program represents a significant long-term commitment to improve living conditions of single soldiers. A total of $10.3B will be invested over the entire program, including Host Nation support. New barracks construction criteria (ACSIM 2003) will improve soldier well-being and provide a better value than the previous 1+1 standard. The new criteria are less restrictive and incorporate industry standards at no additional cost. Barracks can now be designed to increase the size of the modules. Private areas can also be enlarged by reducing the space needed for circulation and utility systems. New criteria went into effect with the FY03 program. DOD's goal is to eliminate inadequate permanent party barracks by FY07. The Army is unable to support additional funds to buy out the program until FY10 or beyond.

The Army Barracks Program is expected to result in energy savings of 900,000 MBtu/year of energy savings due to the higher performance standards of the upgraded and new buildings over previous building stock. Over time, this would lower the glide path metric by about 1-2 percent.[*]

Design and Build Sustainably

Sustainability initiatives require an integrated design approach to the life-cycle of buildings and infrastructure. Sustainable design incorporates energy efficiency, the

[*] Calculations based on MILCON construction and renovation data from Barracks Master Plan, HQRADDS data Dec 2002 and UIUC/BRC energy estimates.

use of renewables and passive tempering, the reduction or elimination of toxic substances, improvements to indoor air quality (IAQ), efficiency in resource and materials, the recycling of building materials and construction waste, the use of recycled materials, and the reduction of wastes during the entire life-cycle. The Office of the Chief of Engineers (OCE) has the mission to incorporate sustainability principles into the Army's design and construction process. This has been accomplished through the use of the Sustainable Project Rating Tool (SPiRiT) to rate new construction projects (Flanders, Schneider et al. 2000). SPiRiT is based on the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System (USGBC 2000). The Army will transition to LEED at a later date using either Version 3.0 (which is now scheduled for 2006 or later), or to the LEED for New Construction Campus Application Guide (which is scheduled for late 2004 or early 2005). All projects starting in FY06 are required to attain the Gold rating level based on SPiRiT (Beranek 2003). The SPiRiT rating requirement also applies to family housing and projects under the Residential Communities Initiative. Attaining a SPiRiT rating at the Bronze level also applies to OMA projects. Vertical construction, such as buildings, will achieve a SPiRiT rating and horizontal construction, such as hardstands, will incorporate to the maximum extent the tenets of sustainable design.

Sustainable design and development costs will be documented on DD 1391 forms. Installations are encouraged to approach both land use planning and urban design in a holistic manner and integrate it with energy planning and building design. Additional information on sustainable design is available on in the Whole Building Design Guide, a web-based tool (located at www.wdbg.org), which serves as a portal to the design principles and other resources needed to construct cost-effective, sustainable buildings.

Improve Utility Security and Flexibility

The Army must protect its interdependent network of critical physical and information infrastructures from disruptions. It must sustain the natural resource supplies to ensure utility services are available as needed. This will require enhancing energy flexibility by reducing the use of foreign energy sources, increasing multi-fueling options, installing renewable energy technologies and distributed generation technologies, and increasing the use of alternative fuel vehicles. the Army must mitigate unacceptable risk by exploring the use of distributed generation options. In most cases, larger scale, off-grid, electrical generation systems will be privately owned and operated. The Army should aggregate energy purchases regionally to leverage buying power, and obtain electricity generated from clean, renewable sources.

Utility Security

Energy surety is the proper combination of safety, reliability, and security. This along with sustainability of supplies (persistent, clean, and affordable) make up the complex set of issues that must be addressed in ensuring energy is available in the right place, at the right time, in the right amounts at the right price for Army installations. Energy surety is enhanced by anticipating for and making plans to address the issues of potential disruptions, diversity of sources and delivery mechanisms, physical security, and the use of distributed energy resources such as renewable energy and on-site generation technology.

Army installations are required to develop an Installation Utilities Management Plan according to AR420-49 (ACSIM 1997). Energy security plans address current utility practices, current and future needs based on mission, size, economic, and environmental considerations. It identifies required resources and outlines a strategy to implement program options. Part of this process is to identify utility vulnerability of basic mission requirements to energy disruptions, assess the risk of such disruptions, and prepare remedial action plans to ensure mission support in event of disruption of major utility systems. Subject to findings of vulnerability assessments, critical nodes of assessed systems with unacceptable risk implications to mission achievement shall be nominated for inclusion in the Critical Asset Assurance Program (CAAP) under DOD Directive 5160.54, dated 20 January 1998.

Installations will develop and implement emergency response plans for each type of utility service. These plans will be developed in coordination with the local utilities, the provost marshal, and the installation emergency and disaster relief activities. The IUMP should address not only issues of major utility disruptions, but consider the planning of effective diversification of energy sources and generating capability to transition the installation over time to a more robust energy system that addresses the surety and sustainability issues. A checklist summarizing the requirements of DEPPM 92-1, DOD Energy Security Policy, and AR420-49 is included in Appendix C.

Flexibility of source fuels

Petroleum

Since 60 percent of the U.S. petroleum supply is now imported, reducing the use of petroleum reduces dependence on foreign sources. The use of petroleum as an energy source for buildings and heating plants is discouraged. Installations should investigate alternative fuels such as natural gas and renewables that are less carbon intensive and are less likely to be disrupted. Where fuel switching is not possi-

ble, maximum efforts will be taken to improve the efficiency of plants and systems using petroleum based fuels and reducing the demand for this resource. These projects should take precedence over competing projects. Petroleum may be used for a backup fuel in the case where natural gas contract is interruptible, although propane/air is the preferred backup fuel.

Duel Fuel Capability

Where possible and economically feasible, dual fuel capability should be provided to the maximum extent possible, especially in central plants. Consideration should be given not only to conventional fuels (natural gas, petroleum, propane/LPG), but also to alternative fuels such as biogas, biofuels, and renewables such as wood and refuse derived fuels.

Renewables

Increasing the use of renewables such as solar, wind, geothermal, low-head hydro, and biomass should be a major priority. The Army is committed to creating opportunities to install renewable energy technologies and purchase electricity generated from renewable sources when life-cycle cost-effective to enhance energy flexibility. Passive solar designs, such as building orientation and window placement and sizing, shall be implemented in a variety of building types and new facility construction. Installations shall purchase renewable energy generated from solar, wind, geothermal, and biomass sources when cost-effective. The Army will join other Defense Components to aggregate regionally when considering renewable energy purchases to leverage buying power and produce economy of scale savings. Exploration in efficiency opportunities in renewable energy technologies such as wind, biomass, geothermal, ground source heat pumps, and photovoltaics shall be pursued when life-cycle cost effective.

The Army's goal is to have the equivalent of 2.5 percent of facilities' electricity consumption come from new renewable energy sources by 2005. New renewable energy would include any renewable energy acquired by the Army after 1990. The goal is a moving target and is based on the current year's consumption. Using 2002 energy consumption data, the goal would equal 214 gigawatt-hours (GWh) of electricity consumption annually or 730 billion Btu. In FY02, the Army had 69.65 GWh of new renewable energy purchases and 59.25 GWh of self generated renewable electricity, for a total of 128.9 GWh.

To accomplish the goal, installations will require maximum flexibility to obtain renewable energy in a manner that makes the most economic sense, and apply it wherever it is most advantageous. Although the goal is measured against facility

electricity use because that is where the greatest opportunity for renewable energy exists, the Army is allowed to substitute renewable energy generated or used in many situations, including transportation, energy intensive facilities, or outside a facility. For example:

- On- and off-grid power technologies
- Thermal technologies
- Renewable transportation fuels (ethanol, hydrogen derived from renewable energy, etc.)
- Passive solar energy captured by equipment and building design
- Renewable energy mechanical power
- Renewable energy from projects on facilities facilitated by the Army, for example, a geothermal project on Army land where the Army assisted with the determining the site for the project.

In FY02, the Army also produced 1,821 billion Btu of other renewable energy. This puts the Army well past the Federal goals, but it does not mean that the Army should stop there. The Army will strive to maximize its use of renewable energy as cost effective projects are identified and developed. Preliminary analysis indicated that about an additional 2.1 TBtu of renewable energy projects are viable and cost effective within the Army.

Technologies that produce renewable energy resources such as solar, wind, geothermal, and biomass have advanced significantly since the early 1990s. By displacing conventional engine-driven generators and fossil fuel heating equipment, these technologies provide the additional environmental benefit of reducing harmful air emissions. Building-integrated solar technologies, such as photovoltaic power systems, solar water heating systems, and transpired solar collectors (solar walls), are specifically promoted for use, through the President's Million Solar Roofs Initiative (MSR), which is part of the Buildings for the 21st Century program. The Army is committed to the MSR initiative. The Army has approximately 3,800 "solar roofs" in use at its installations, and has requested assistance from DOE to help with the maintenance and repair of several photovoltaic systems. As of FY03, the Army has over 1.6 MW of installed solar generation at installations.

Renewable energy projects implemented to provide electricity or heat for facilities have included ground source heat pumps, solar water heating systems, and photovoltaic systems to generate electricity for isolated loads such as range targets, air field landing strip lighting, and remote water pumping stations. Examples of small photovoltaic units for a single building and larger grid connected systems, such as the 450 kW photovoltaic utility size array at Yuma Proving Ground, have been demonstrated. Active solar heating applications have included maintenance facility solar walls, swimming pool heating, and hot water heating.

Bridging to Hydrogen

The Army should move towards technologies and systems that may be considered bridges to the hydrogen economy. These technologies generally use natural gas, propane, or a biofuels as their energy source. This allows transition to hydrogen at a later date when it becomes feasible and desirable.

Alternative Fuel Vehicles

In accordance with Executive Order 13149, "Greening the Government through Federal Fleet and Transportation Efficiency" (Office of the Press Secretary, The White House 2000), the Army will reduce its petroleum consumption through improvements in fleet fuel efficiency and the use of alternative fuel vehicles (AFVs) and alternative fuels. The goal is to reduce its entire vehicle fleet's annual petroleum consumption by at least 20 percent by the end of FY05, compared with FY99 petroleum consumption levels. Measures include: the use of alternative fuels in light, medium, and heavy-duty vehicles; the acquisition of vehicles with higher fuel economy, including hybrid vehicles; the substitution of cars for light trucks; an increase in vehicle load factors; a decrease in vehicle miles traveled; and a decrease in fleet size. Army strategies include the following:

- Acquire AFV (75 percent of new nontactical vehicle acquisitions) and nontactical hybrid light duty trucks (5 percent by FY05 and 10 percent by FY07 for EPAct covered areas; 100 percent in FY05 for non EPAct covered areas).
- Increasing the average EPA fuel economy rating of passenger cars and light trucks acquired by at least 3 mpg by the end of FY05 compared to FY99 acquisitions.

To support the use of alternative fuel in AFVs, installations should arrange for fueling at commercial facilities that offer alternative fuels for sale to the public. Installation should team with State, local, and private entities to support the expansion and use of public access alternative fuel refueling stations or use the authority granted to them in section 304 of the Energy Policy Act of 1992 to establish nonpublic access alternative fuel infrastructure for fueling Federal AFVs where public fueling is unavailable.

Distributed Generation

Distributed generation (DG), the generation of electricity close to the point of use, is an appealing option for increasing power security. Multiple generating sources distributed around the local electrical system reduce the overall system vulnerability to intentional disruption and increase system reliability with redundancy of generators. Additionally, on-site generation is more physically secure than off-site genera-

tion as it is within the perimeter of the installation and eliminates possible electrical interruptions due to failure of the outside generating power plants or transmission lines. Energy security is further enhanced by diversity of sources and delivery mechanisms.

Distributed Energy Resources shall be used for on-site generation using micro-turbines, fuel cells, combined heat and power, and renewable technologies when determined to be life-cycle cost effective or to provide flexibility and security to mitigate unacceptable risk. Other benefits include energy efficiency, pollution prevention, source energy reductions, avoided infrastructure costs, and expedited service. The Army's policy is to privatize its electrical distribution systems (and other utilities). In most cases, larger scale, off-grid, electrical generation systems should be privately owned and operated. Off-grid generation, owned and operated by the Army may make sense for mission criticality and remote sites when it is life-cycle cost-effective. In these cases, innovative energy generation technologies such as solar lighting, large photovoltaic arrays, wind turbine generators, micro-turbines and fuel cell demonstration projects shall be used.

Energy Procurement Strategy

EO 13123 requires that the Army take advantage of competitive opportunities in the electricity and natural gas markets to reduce costs and enhance services. Installations are encouraged to partner with Defense Energy Support Center (DESC) to identify and develop risk mitigation strategies appropriate for the risk preference profile of the end-user and are encouraged to aggregate demand across facilities or agencies to maximize the economic advantage.

In addition, the Army and installations engage in periodic review of all available utility rate tariffs for installations to determine that the installations are receiving the best rate for the load profile of the installation.

Green Power Purchases

Installations are encouraged to participate in purchases of green power. Green power is defined by the Center for Resource Solutions (CRS) Green-e products certification requirements. The Green-e Program is a voluntary certification and verification program for green electricity products. Those products exhibiting the Green-e logo are greener and cleaner than the average retail electricity product sold in that particular region. To be eligible for the Green-e logo, companies must meet certain threshold criteria for their products. Criteria include qualified sources of renewable energy content such as solar electric, wind, geothermal, biomass and small or certified low-impact hydro facilities; "new" renewable energy content (sup-

porting new generation capacity); emissions criteria for the nonrenewable portion of the energy product; absence of nuclear power; and other criteria regarding renewable portfolio standards and block products. Criteria are often specific per state or region of the United States. Refer to the Green-e standard for more details (www.green-e.org).

Both Fort Carson and the Military District of Washington are participating in the purchase of green power.

Regional Electrical Purchases

Army components are encouraged to partner with DESC and aggregate regional electricity requirements (including renewable energy) to competitively procure electricity, ancillary and incidental services needed to meet the identified requirements. Award determinations shall be based on best value compared to the applicable utility tariff available under a Utility Services Contract.

Direct Supply Natural Gas Program (DSNG)

The Army's policy is to competitively acquire direct supply natural gas under the DSNG Program, managed by DESC, when cost effective and the anticipated reduced energy costs have the same degree of supply reliability as other practicable alternative energy sources. DESC and the Army may mutually agree to exclude an installation from a DSNG contract when: (1) an award is uneconomical, (2) the local distribution company (LDC) does not provide transportation from the city-gate to the end use customer, or (3) if ongoing or pending legal or regulatory action adversely impacts participation in the program. IMA is responsible for entering into and maintaining all necessary LDC transportation agreements to support delivery to the burner-tip and for ensuring that sufficient funding is available for payment.

Increase Utility and Building Efficiency

The Army intends to meet mandated energy conservation targets, to use best management practices for water use, and to meet emission reduction goals. A combination of metering, audits, and engineering modeling will monitor progress and prioritize technology infusion efforts. The systematic purchase of efficient products, incorporating best management practices for water and energy use, will achieve the desired outcomes. Electrical demand reductions and optimized facility operations will result in cost savings and increased comfort and occupant productivity.

Efficiency Mandates

Energy Use Intensity Targets

Army buildings (including industrial and laboratories) will reduce their energy consumption per gross square foot by 2 percent per year starting in FY2004 through 2013 relative to the FY 2001 energy consumption (baseline year). Additional goals for 2014 through 2021 will be set by the Department of Energy in 2012. These requirements should supersede all previous goals and baselines, as meeting these will ensure meeting the previous goals.

BMPs for Water Conservation

The EO requires Federal agencies to reduce water consumption and associated energy use in its facilities. EPAct 2003 also extends the definition of water conservation measure to be a measure that improves the efficiency of water use, is life-cycle cost effective, and involves water conservation, water recycling or reuse, more efficient treatment of wastewater or stormwater, improvement in operation or maintenance efficiencies, retrofit activities, or other related activities. The Army's water conservation goals are in line with these requirements including implementing cost-effective water efficiency programs as defined in a comprehensive water management plan and, implementing at least four water efficiency improvement Best Management Practices (BMP) according to the schedule laid out by FEMP:* in 15 percent of facilities by 31 December 2004, 40 percent by 31 December 2006, 75 percent by 31 December 2008 and 100 percent by 31 December 2010.

Building Metering Program

The proposed EPAct 2003 requires that the Department of Energy establish guidelines requiring that all buildings, for the purposes of efficient use of energy and reduction in the cost of electricity used in buildings, be metered and sub-metered. Within 6 months of establishments of guidelines, the Army must submit an implementation plan to the Secretary of Energy.

The Army Building Metering Program should establish a metering framework to make maximum use of resources and the most effective use of advanced metering technology or devices that provide data at least daily and that measure at least

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* See www.eere.energy.gov/femp/resources/waterguide.html

hourly consumption of electricity. Technologies such as centralized meter reading and wireless technology should be used. Metering will be used for benchmarking and accounting. The establishment of metering for reimbursable tenants will be the first priority. The metering will also be used to establish building performance metrics and comply with the requirements for ENERGY STAR® Buildings[SM]. Initial guidance from ACSIM is that only buildings that are have sufficient energy use to warrant the cost of metering will be metered. These buildings must consume approximately $500/month of electricity or be at least 10,000 sf in size.

Audits and Models

The Army will continue to meet the requirements of EO13123 to audit 10 percent of facilities space annually. In addition to audits, assessments will be undertaken to identify retrofit opportunities. These assessments will range from building surveys conducted by the servicing utilities, detailed assessments and engineering designs conducted for ESPC and UESC projects, and computer-based modeling to identify retrofits using tools like the Renewables and Energy Efficiency Planning (REEP)* and Facility Energy Decision System (FEDS). It is recommended that the Energy Manager Project Assistant (PA) software be used for conformity of economic analyses and consistency during project development (www.cecer.army.mil/SEP/pa.htm).

Purchase Efficient Products

To the extent available and cost effective, the Army will purchase ENERGY STAR® labeled products, or, for those product types not covered by the EPA/DOE ENERGY STAR® labeling program, products whose energy efficiency rates in the upper 25 percent as designated by the Federal Energy Management Program.

The ENERGY STAR® labeling program is a joint effort between EPA and DOE to get manufacturers (and some retailers) to identify efficient products with an easily recognizable logo, the ENERGY STAR®. Since this is a nation-wide labeling program covering multiple products, it makes it very simple for customers to identify truly efficient models among those offered, for instance, on a retail floor, or among various models listed in a product catalog. The program includes a wide variety of office equipment and home heating and cooling products, as well as many consumer audio and video products (e.g., TVs, VCRs, and DVD players), appliances, and residential

* See www.cecer.army.mil/reep/reep.html

windows. Some commercial equipment was also covered, such as exit signs, low-voltage distribution transformers, and roof products.

DOE/FEMP publishes a series of *Product Energy Efficiency Recommendations*, which delineate the efficiency levels that meet the ENERGY STAR® and "upper 25 percent" requirements of the Executive Order. The *Recommendations* also provide cost-effectiveness examples, tips on important product selection parameters such as sizing and fuel choice, and information about buying efficient products from the Federal supply agencies: the Defense Logistics Agency (DLA) and the GSA. The *Recommendations*, which now cover more than 30 products, are available on FEMP's Web site (www.eren.doe.gov/femp/procurement).

DLA's customers rely heavily on the information in the Federal Logistics Information System (FLIS) database to procure products and equipment. The FLIS catalogs millions of items by "national stock numbers" (NSNs), which can be accessed by vendor name or code. To the greatest extent practicable, installations shall select ENERGY STAR® and other energy efficient products when acquiring energy-using products, either of-the-shelf, or through DLA or GSA.

In the case of electric motors rated from 1 to 500 horsepower, only premium efficiency motors will be purchased.

The Army should conduct a study and establish the best practice technologies for energy and water management and institute a buy-out (total replacement) program for these technologies. Several technologies such as T-8 lamps, LED exit signs and low flow toilets are proven solid investments that do not require further evaluation before proceeding with implementation. This type of equipment should be put on a "just do it" list.

Optimize Building Operations

The concepts of commissioning and continuous commissioning of building systems should be incorporated into the standard practices of building and system operation and maintenance procedures and practices. Major savings of up to 25 percent of operating energy is available through these processes. New buildings and major OMA projects must undergo a fundamental commissioning process as required by SPiRiT. Once the building is operational, concepts of continuous commissioning using the building's DDC system or the installation's EMCS system to monitor operations and efficiency of energized systems is highly recommended.

Electrical Power Demand Reductions

Electricity is the most expensive form of energy used at Army installations, both in commodity costs and demand costs. Although the Army has made significant progress in reducing total energy consumption, the electrical intensity steadily increased throughout the last decade or two and had finally begun to decrease in the latter half of the 1990s. It has reached plateau for the past 4 years and costs have begun to slowly rise. Figure 5 shows Army electrical intensity and how the large investments in energy savings and program emphasis have turned the graph downward. Greater penetration of air-conditioning and the overall trend toward electrification experienced nation-wide have been the main driving forces in intensity increases. The widespread expansion of information technology within the Army facility structure increased electrical plug loads. Increased emphasis on reducing electrical consumption and demand has been successful in decreasing intensity and is an ongoing imperative.

As a result of the President's 3 May 2001 Directive (Bush 2001), Army installations' emergency load reduction plans were updated. Installations must continue to identify load shedding techniques to cut electricity consumption in buildings and facilities during power emergencies. Examples of these techniques include: EMCS, submetering, cogeneration, TES systems, duty cycling of A/C in military family housing by EMCS, alternative energy sources for air-conditioning such as desiccant and direct-fired chillers, and turning off unneeded lights with motion sensors and separate lighting circuits. Additional energy conservation opportunities with great potential for reducing electrical power consumption and demand are improved lighting and increased chiller efficiencies. Lighting represents a significant portion of the facilities energy consumption. Examples of lighting projects include installation of high efficiency luminaires, lighting controls, and the use of daylighting. Since space cooling accounts for about one third of the electrical energy consumed by the Army, it is responsible for much of the peak demand the coincident peak demand costs. During the past 20 years, the average chiller efficiency has improved nearly 40 percent. Replacement of old chillers with current higher efficiency models not only helps the Army conserve energy, but also meets the CFC refrigerant phase out requirements resulting from provisions of the Clean Air Act, 1990 Amendments. Other projects being implemented to reduce electrical energy use at installations are high efficiency motors, refrigeration equipment, and improved building energy management controls.

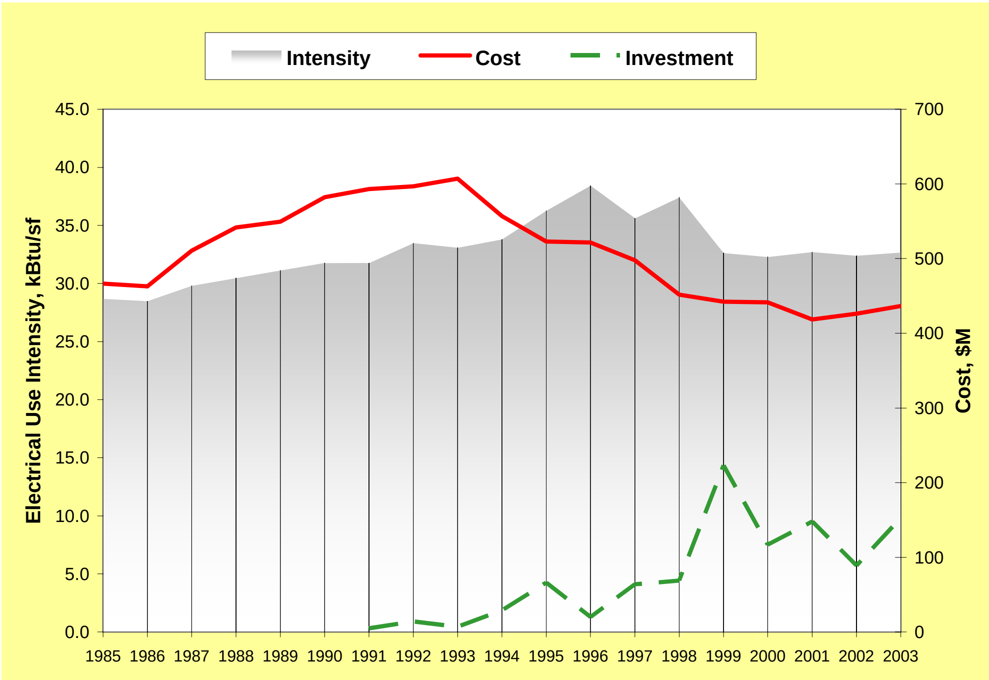

Figure 5. Army electrical intensity, cost, and efficiency investment.

6 Delivering Outcomes

Program Outcomes

This recommended strategy presents a methodology and policy framework to achieve the Army's vision and goals for installation facilities and utilities. The comprehensive framework ensures that outcomes are realized and that the dual mission for installations is achieved through enabling readiness, providing reach-back support, and establishing quality communities. Utility security is achieved as cost-effectiveness, reliability, and sustainability are combined appropriately. Quality facilities and modern utility systems result from the three thrust areas of modernization, security, and efficiency. Environmental stewardship is maintained and regional resiliency is enhanced through programmatic actions and integration with local communities for mutual support.

Resource Requirements

Significant resources are required to meet the goals and requirements of the Army Energy Program. An investment strategy to meet the 2013 goals of the energy program is comprised of energy saving projects, renewable energy projects, and water saving projects. Table 6 lists the total investment requirement to meet the Army's energy and water management goals (estimated at $1.7B). (Table 7 lists unit costs for energy savings.) This investment would result in an ongoing saving of 11TBtu/yr of site energy (13.5 percent of current consumption), an additional 3.2TBtu/yr in source energy, 293MW of electrical demand, 10.8Bgal/yr of water (14.4 percent of current consumption), with a simple payback of 5 years, or a life cycle cost effectiveness if the suggested mix of in-house and out of house financing takes place.

Water projects consistently show the quickest payback and highest return on investment, followed by energy efficiency projects. After these, load shifting (a money saver) and cogeneration projects (a secure and diversified option) are close contenders, depending on local priorities. Renewables continue to trail on project lists based on face value economics. The facts that America has vast land resources and fossil fuel supplies are being depleted and their use leads to negative global impacts, will continue lead to us to renewable energy as a reasonable alternative.

Table 6. Army-wide energy and water investment potential.

	Potential Invest. ($M*)	Invest.* Govt. Finc. ($M*)	Suggested $ split (%Govt. /%3rd Party)	Invest.* Third Party Finc. ($M*)	Energy Svgs. Site (TBtu/yr)	Energy Svgs. Source** (TBtu/yr)	Elec. Gen. (TBtu/yr)	Water Svgs (Bgal/yr)	Demand Svgs (MW)	Poll. Reduct. (Mton/yr)	Annual Savings ($M/yr)	SPB* (yrs)	SIR*- Govt. Finc.	SIR* Thir Part Finc
Projects:														
Energy Efficiency Projects	**962**	437.4	(20/80)	1093.4	8.1				166.4	1.00	88.5	4.9	2.5	1.0
Electrical Load Shifting Projects	**51.3**	51.3	(100/0)	128.3	-1.0	0.4			52.9	0.00	8.0	6.4	2.1	0.8
Distributed Generation/ Cogeneration	**200**	90.8	(20/80)	227.0	-1.2	2.8	1.6		56.3	0.21	14.9	6.1	2.0	0.8
Renewable Energy Projects	**276.4**	157.9	(50/50)	394.8	2.1				17.8	0.24	17.7	8.9	1.7	0.7
Water Efficiency Projects	**194**	77.4	(0/100)	193.5	0.5			10.8		0.0	32.49	2.4	4.3	1.7
totals	**1683.7**	814.8		2036.9	**10.8**	**3.2**	1.6	**10.8**	**293.4**	1.5	161.6	**5.0**		

**includes maintenance costs*

***source energy savings w/ thermal recovery credit*

(13.5% of current consumption) *(14.4% of current consumption)*

Table 7. Unit costs for energy, demand, and water savings.

	Unit Costs for Energy Svgs		Unit Costs for Demand Svgs		Unit Costs for Water Svgs	
	Government Financed $M*/TBtu Saved	**Third Party Finc. $M*/TBtu Saved**	**Govt. Finc. $M*/MW Saved**	**Third Party Finc. $M*/MW Saved**	**Govt. Finc. $M*/Bgal Saved**	**Third Party Finc. $M*/Bgal Saved**
Energy Efficiency Projects	53.7	134.3				
Electrical Load Shifting Projects			1.0	2.4		
Distributed Generation/ Cogeneration**	32.7	81.9	1.6	3.2		
Renewable Energy Projects	73.7	184.2	8.9	22.2		
Water Efficiency Projects					7.1	17.8
New Construction	23.0					

**includes maintenance costs*

***source energy savings w/ thermal recovery credit*

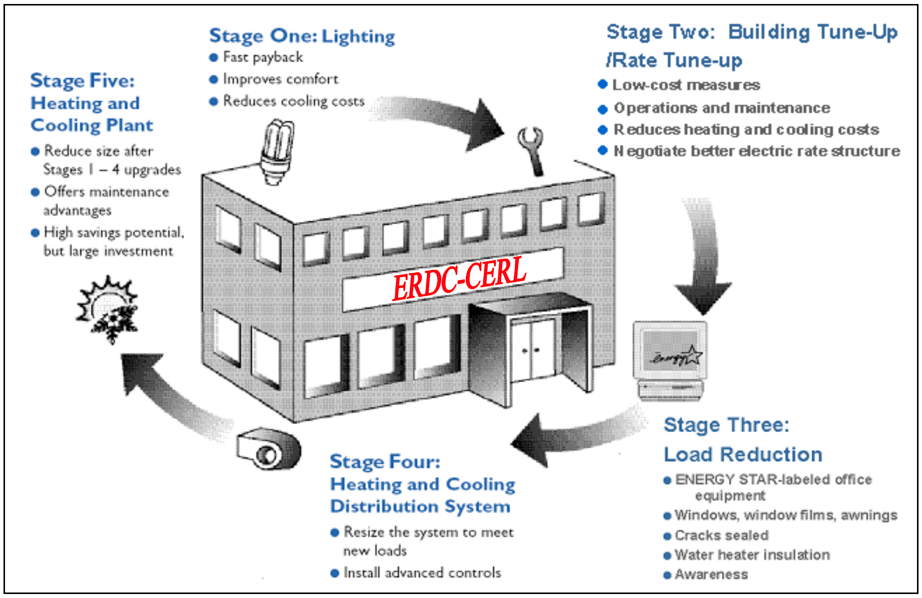

Figure 6. Efficiency retrofit projects in priority order.

Prioritization of efficiency projects should follow the stages shown in Figure 6, adapted from Energy Star recommendations (EPA 2004). Start with lighting (straightforward, high payback best bet projects). Following that, building commissioning, which catches up on backlogged maintenance and optimizes equipment efficiency, is appropriate. At this stage also, a review of utility rate structures is a good idea. We have found that electric suppliers sometimes have rates that they cannot tell you about unless you ask (Lin 2003). Stage three is load reductions including awareness program. This is followed by distribution and controls upgrades. Efficiency projects should end with heating and cooling plant replacements if necessary. This procedure reaps the rewards of high return on investment projects first to free up funds for most expensive efforts later, and it reduces the loads required of primary conditioning equipment to allow purchasing smaller, right-sized heating and cooling equipment.

The third party financing methods need to be scrutinized and carefully managed. Historically, an investment of $50 to $60 million is required to save an ongoing TBtu/yr with in-house projects and about $120 to $150 million ($150M with regular ESPCs, and $120M with super ESPCs* to save an ongoing TBtu/yr using alternative financing. Third party financing should cost more than government financing

* Based on Spreadsheet from Mike Kishiyoma, CEHND, October 2002 and data from FEMP web site, September 2003.

for several reasons, e.g., contractors need to borrow money at the private borrowing rate, they are entitled to a profit, they need to pay taxes on their profits, and they are assuming a risk to guarantee savings. However, these requirements do not add up to the 100-200 percent mark up sometimes experienced. Other causes for discrepancy include not specifying maintenance for in-house projects, not having common energy and economic calculation methods, and confusion about site and source energy accounting.

Given present market conditions, alternative financing returns smaller, if any monetary gains to the government compared with using in-house resources. However, third party financing does accomplish the desired commodity savings requirements and environmental and sustainability goals that lack adequate funding. It does upgrade old and outdated facilities. It gets the job done now, rather than at some undetermined time in the future. It infuses money into the economy. It gets equipment maintenance funded, which is often so far down the list of competing priorities that it is deferred—a practice that leads to compromised or nonexistent returns on efficiency investments. Also, it allows the Army to concentrate on its core competencies of warfighting. However, there are many opportunities to work smarter and negotiate better agreements with third party financiers, which should be pursued. Stipulated savings should not be allowed and the Army should consider shared risk agreements on ESPCs to reduce support contractor unknowns and, thereby, reduce the contingencies built into in these contracts.

For this analysis, maintenance costs were included in both in-house and third party financed projects. Table 7 lists unit costs for energy savings, demand savings, and water savings. Energy efficiency projects cost $54-134M/(TBtu/yr) saved, load shifting projects cost $1-2M/MW saved, cogeneration costs $33-82M/(TBtu/yr) saved, and water efficiency projects cost $7-18M/(Bgal/yr). Of striking contrast is the cost of constructing new facilities, where approximately $23M in construction cost will result in equivalent square footage that uses approximately 1TBtu/yr less than existing construction,[*] making new construction a very viable alternative for increasing energy efficiency.

[*] Personal communication between Donald Fournier and AFCESA, and references that show costs range from $15-30M/TBtu saved. It costs more to save electricity (high end) than natural gas (low end). References: WorkPlace New Construction Program, Vermont Gas Systems, Inc. http://www.aceee.org/ngbestprac/vgsnewconst.pdf downloaded 12 July 2004; New Construction Program, NYSERDA, undated, accessed 12 July 2004 through URL http://www.nyserda.org/ and The Cost and Performance of Residental New Construction Programs, LBNL, E. Vine, Berkeley, CA, 1995.

7 Summary

The Army Energy and Water Management program has been evolving for over 30 years. It continues to be refined and adjusted as situations change and the Army transforms. The Army has consistently met requirements and goals of the program and intends to continue to meet current and future goals and requirements. The anticipated passage of the baseline and goal requirements of the Energy Policy Act of 2003 will present the Army with even greater challenges. Future change will occur at an accelerated pace—internal and external forces will cause the price and availability of energy and water to vary widely; security of energy sources and transmission networks will become an increasingly important issue.

This document provides a strategic policy and operating framework for meeting these new challenges. Although EPAct2003 is still pending, the provisions of the Act are reasonable and make good business, environmental, and tactical sense. Even if EPAct2003 does not become law, it is assumed that either legislation containing similar Federal requirements will ultimately be enacted, or an Executive Order with the same provisions promulgated. Based on that expectation, this strategy incorporates EPAct2003's construction and operational requirements in a proactive, forward thinking manner intended to avoid a chaotic "catch up" drill and potential long-term mistakes that cannot be easily remedied.

This strategy assesses the current state of Army stewardship, which is presently on track, but experiencing diminishing returns and insufficiently poised to meet future constraints and requirements. It synthesizes mission, constraints, requirements, and desires into a vision of where we hope to be in the future. This vision is supporting the installations' mission by providing secure, efficient, reliable, and sustainable energy and water services with effective and proficient management of commodities, facilities, and utilities in partnership with the surrounding communities. This strategy encompasses the guiding operational principles that permeate Army guidance—being holistic, responsible, progressive, and sustainable. It lays out three primary goals: (1) modernizing infrastructure, (2) improving utility security and flexibility, and (3) increasing utility and building efficiency. It aligns ongoing programs under these goals to show how present efforts get us closer to where we want to be. Finally, it identifies where gaps exist in supporting activities — research and development, planning, programming, collaboration, review, and feedback—to assure that objectives can be attained.

We recommend that this framework, overarching strategy, and guiding principles of operation be reviewed by Army leadership, appropriately modified, and then adopted by the Army as a comprehensive energy and water management policy.

The heart and soul of the Army Energy Program is the cadre of trained, professional energy managers in the field. Yet, continued success in a climate of increasingly stringent requirements, requires a more centralized approach incorporating formal planning, review, and feedback. A change in philosophy to a tiered planning approach is required to ensure success and guarantee outcomes. Optimized operations, heightened awareness, increased coordination and collaboration, and attention to energy reporting will also be required.

To meet the requirements of the expected glide path out to 2013, the Army has to reduce facility energy consumption by approximately 14 TBtu/yr. This must be accomplished by a combination of highly efficient new buildings, more efficient existing buildings and utility systems, and significantly increasing use of on-site renewable energy. It is estimated that present design standards for the barracks program will save about 0.9 TBtu/yr and the housing program will save about 1.5 TBtu/yr, leaving approximately 11-12 TBtu/yr to be saved in other programs and projects.

A combination of energy efficiency, water efficiency, and renewable projects shows a potential energy savings near the required 11TBtu/yr. Enhanced energy savings from more efficient new construction and utility upgrades along with awareness activities will ensure a margin of safety in attaining goals. An estimated $1.7B investment in technology infusion Army wide would result in an ongoing saving of 11TBtu/yr of site energy (13.5 percent of current consumption), an additional 3.2TBtu/yr in source energy, 293MW of electrical demand, 10.8Bgal/yr of water (14.4 percent of current consumption). This could be accomplished with a modified simple payback of 5 years, or a life cycle cost effectiveness if the suggested mix of in-house and out of house financing takes place. (This assumes that 86 percent of the project dollars would be financed with alternative financing.) All of these represent true investments and are self-compensating. Accomplishing the goals with alternative financing will return much smaller monetary gains to the government than using in-house financial resources, but will attain the desired utility reductions.

The Army can reach its full stewardship potential by implementing all cost effective technologies, and by procuring, maintaining, and operating commodities, facilities and utilities to modern standards of excellence. Specific recommendations for program strategies, goals, and methods of attainment are provided below, by category of program execution.

Management and Technical Support Initiatives

Coordination of Management and Technical Support entails strategic planning to meet policy objectives by interpreting information; incorporating research and development insights; supporting continuing technology gap endeavors; arranging appropriate financing; forming partnerships, maintaining awareness with training, media campaigns, awards and showcases; and implementing an execution plan with oversight and evaluation.

A more centralized approach with formal program management through the IMA is recommended. This centralized approach should institute coordinated tiered national, regional, and installation level Long Range Energy Master Plans and Business Implementation Plans. Guidance on procedures, metrics, common yardstick calculations and updated software should be provided from OACSIM to the IMAs and installations. Plans should be created and coordinated such that neither the big picture of national analysis nor the individual circumstances of the installation level are lost. Information and ideas flow up, down, and across the management structure. The plans should come up from the installation level and be collated into regional plans that add assessments and decisions made with a regional perspective to most effectively meet Army-wide goals as an entire unit while not necessarily making the same progress at each installation. Doing what makes sense where it is most appropriate produces the soundest overall stewardship.

Regional plans should then be collated into an overall Army Master Plan, which again reviews the entire playing field to increase the potential for overall success. Resource requirements should be identified, prioritized, and directed at the IMA level. Part of the funding coordination and incentive management should be the full funding of the J Account at the installation level and institution of the retained savings concept.

The establishment of an Army Energy Steering Committee (AESC) to help formulate policy, an Army Energy Technical Development Team (AETDT) to direct and support R&D efforts, and an Army Energy Technical Assistance Team (AETAT) to provide technical, strategic and tactical guidance for implementing the comprehensive Army Energy and Water Management Program is recommended. The AETAT should be pre-funded and available to installations on an “on-call” basis to provide needed expertise and assistance.

Partnerships with the other services should be expanded as the DOD moves forward to a Joint Expeditionary Force. Inclusion of the representatives for the other services is recommended for the proposed AETDT, as the Army is the only defense group conducting installation R&D that could benefit all services and be supported

by all services. Additionally some Army R&D has been short on developing upfront proponency and could be enhanced by a larger user community. Tri-service input is also recommended for the AESC as there is much to be gained from collaboration across services in terms of best practices, lessons learned and specifics on defense application of technology and security ideas.

Regular collaboration is needed between members of the “Army family” i.e., OACSIM; IMA; Installations; the Corps of Engineers’ centers of expertise, support, and research; the Defense Energy Support Center (DESC); and the GSA. These are resources for knowledge and cost sharing and leveraged buying power.

Guidance documents such as AR11-27, AR420-49, and the Energy Managers Handbook should be updated to reflect current component groups, define goals and requirements, and institute formal tiered strategic planning and installation long-range energy management plans.

The Army should expand its Energy Forum held in conjunction with the annual Energy Conference sponsored by the DOE, DOD, and General Services Administration (GSA) 2 full days or more. Installation energy managers should be funded to attend both the conference and the forum. The Army plans to encourage IMA Region-sponsored installation energy manager Forums. These are an opportunity for installation energy managers within each Region to discuss and plan strategies for meeting energy and water management goals and learn about projects successes, funding and financing opportunities, new and emerging technologies, and new approaches to energy and water management. It is recommended that these forums be sufficiently extensive to allow in-depth discussion and learning on experiences with implemented technology and applicability to other locations.

Technology infusion brought about by effective research and development (R&D) is a crucial asset in transitioning to modern, secure, and efficient utility and building systems. To be truly effective, R&D must have a complete funding cycle. Therefore, ACSIM and IMA must embrace the concept and lead the requirements generation and prioritization of needed research, technology evaluations, and implementations. In addition, funding must be programmed for 6.2 (Applied Research), 6.3 (Demonstration and Validation), 6.4/5 (Engineering and Deployment of new technologies). The technology management process must integrate with the traditional Army energy funding and alternative financing mechanisms.

The management of intellectual assets is vital to organizational productivity. The Army should institute an expanded Centralized Knowledge Management System accessed through an Army Energy and Water Management Portal, that would combine existing databases, streamline data retrieval options, increase on-line analysis

capabilities, expand the breadth and depth of the knowledge base, and provide Army resource managers with the information and insight they need. This includes the development of a centralized database of critical information and an Army web portal.

Currently, reporting gaps and inconsistencies in Army databases are common. Linking reporting requirements to funding approval or shifting reporting requirements to utility providers are two potential ways of better tracking utility flows. Further, immediate on-line feedback from the reporting system that flags suspect data and shows utility trends would help increase the likelihood of usable information.

Expanded reporting is recommended as a natural follow-on to the Installation Long Range Energy Management Plans that call for pertinent trending analysis of utility flows that should be updated on an annual basis: specifically, Energy Use Intensity (EUI), percentage of Best Management Practices Implemented for water efficiency, and changes in fuel portfolio and Green House Gas production. Source energy and site energy impacts should be tracked. Additional parameters such as HDD, CDD, population, and industrial production counts should also be tracked to better explain installation and regional deviation from the prescribed glide path and formulate appropriate program adjustments. The percentage of implemented Best Management Practices for Water Efficiency should be tracked along with water and wastewater flows and costs. Additional parameters such as inches of precipitation and population counts should also be tracked. This will prove useful in understanding annual water consumption trends.

It is also recommended that each new construction and major renovation project prominently display its SPiRiT score and that the Army consider registering these projects with the U.S. Green Building Council and rating them according to LEED.

Program Execution

Modernize Infrastructure

The Army must elevate facilities and utilities to modern standards of excellence, function, and reliability to increase effectiveness, quality of life, and efficiency while reducing overall utilities consumption. Recommended are rating and tracking of facility condition and performance, privatizing most utilities and family housing, upgrading utilities and facilities condition level, infusing cost-effective efficiency technologies, and applying sustainable design and construction criteria.

Appropriate funding is required to modernize legacy utility systems and bring the remaining building inventory to C2 standards. This would require defined programs focused through the IMA and directed at specific systems and buildings at installations. The installation energy and water business plans should be the vehicle to prioritize and direct funding.

The Army needs to set higher standards for new and existing buildings for energy performance and sustainable design. The USGBC's LEED for Existing Buildings or the EPA's ENERGY STAR® program (or both) should be adopted for current buildings that are intended to remain in the inventory. E-Benchmark should be adopted for new construction with intent of reducing energy consumption by 30 percent over standards practice. SPiRiT should be updated and merged closer to LEED or the Army should adopt LEED. The EPAct2003 proposed performance standard for new construction of 30 percent below ASHRAE 90.1-2001 should be adopted whether or not it becomes law. This avoids the potential long term mistake of building suboptimal facilities that are retained in the building inventory for an average 50+ years. High performance building module designs that incorporate energy efficiency features according to function, climate, and utility pricing structures should influence recognized best design practices and be incorporated into the Army's standard design library.

It is recommended that additional investigations into energy performance rating protocols be conducted, to better inform effective buildings design and performance evaluation.

Improve Utility Security and Flexibility

The Army must sustain energy and water services to ensure availability of critical utility supplies. This requires enhancing energy flexibility by reducing our dependence on foreign energy sources; increasing multi-fuel options and on-site storage capabilities; and installing renewable energy technologies and evolving distributed generation technologies. The Army should regionally aggregate energy purchases and obtain electricity from clean renewable sources.

The Army should establish a formal review process for Installation Energy Security Plans to include Energy Emergency Preparedness and Operations Plans and Energy Security Remedial Action Plans (if needed). A template for accomplishing this should be developed. The AETAT could also assist in establishing plans.

Installations should consider establishing multiple electric feeders and substations. Current systems are too brittle and subject to easy sabotage.

It is recommended that the Army establish an enhanced renewable energy and fuel storage and diversity program. Central plants should have dual fuel capability or a back up fuel system. Distributed generation assets should be incorporated into new construction and central plants as technology becomes more cost effective and viable. Installations should participate in purchases of green power to enhance sustainability by creating a demand pull and encouraging a more robust electric grid.

Increase Utility and Building Efficiency

It is imperative that the Army continue to meet energy conservation targets, use best management practices for water, and reduce coincident emissions. A combination of metering, audits, and engineering models can monitor progress and prioritize technology infusion efforts. Systematic purchase of efficient products, employment of technologies and controls to reduce electrical demand, and optimization of facility operations will result in cost savings and increased comfort and occupant productivity.

The Army should make a formal decision on how to address the energy and water consumption in privatized housing. Since housing is the most energy efficient square footage in the building inventory and the Army will ultimately pay the utility bills even for privatized housing (whether directly or indirectly), these should be kept in the inventory for energy accounting purposes. If RCI housing is to be removed from the baseline, then this should be done all at once and a new baseline established on OMA buildings and legacy housing only (units planned for RCI, but not yet under contract should also be removed and carried on a separate inventory).

Where practical, the Army should meter all utilities at all buildings and at sub-building tenant level to establish accountability and identify opportunities for improvement. Technologies such as centralized meter reading and wireless technology should be used. Master metering of family housing and metering of billable tenants should be a high priority where not yet implemented.

The Army should conduct a study and establish the best practice technologies for energy and water management and institute a buy-out (total replacement) program for these technologies.

The concepts of commissioning and continuous commissioning of building systems should be incorporated into the standard practices of building and system operation and maintenance procedures. Major savings of up to 25 percent of operating costs are available through these processes. This is a largely untapped “gold mine” for fulfilling our efficiency potential.

Delivering Outcomes

The outcomes from this comprehensive program will help the Army achieve its vision and goals for installation facilities and utilities well into the future. They will enable readiness, provide reach-back support, and establish quality communities. They will achieve utility security by appropriately combining cost-effectiveness, reliability, and sustainability; maintain environmental stewardship; and integrate installations with local communities for mutual support.

The third party financing methods and their associated economics need to be further investigated and evaluated. Energy and water projects currently costs the Army considerably more when it uses third-party funding than when it uses in-house funds. Although there are several reasons why third party financing should cost more than government financing, these requirements do not add up to the 100-200 percent mark up sometimes experienced. Stipulated savings should not be allowed and the Army should consider shared risk agreements on ESPCs, to reduce support contractor unknowns and, thereby, reduce the contingencies built into in these contracts. Abundant opportunities exist to work smarter and to negotiate better agreements with third party financiers; they should be pursued.

The candidate Army Energy and Water Management Strategy presented here represents a careful evaluation of the current program, an identification of its strengths and weaknesses, opportunities for improvement, and a proposed method for facing the emerging needs, threats, and requirements of the next 10 to 15 years. It requires a commitment from Army leadership with dedication and follow-through, a willingness to share ideas and risks, and change operations for increased agility and effectiveness. The seeds of components for this endeavor currently exist in the fine work the Army has already accomplished in energy and water stewardship. Embracing this strategy is the next logical and responsible step, for our generation and those that follow.

8 Conclusion

The candidate strategy presented here is a thoughtful review of existing Army practices and needs for energy and water management, and a recommendation for enhancement. The strategy builds on current efforts, recognizes strengths, identifies and fills in gaps, and advises courses for improvement. A comprehensive, coordinated, proactive approach to sustaining the Army's mission through a disciplined use of resources is necessary to meet the challenges that lie ahead. It is hoped that Army leadership will review this proposed policy and framework, appropriately modify it, and then adopt it as the Army Energy and Water Management Program for the 21st Century.

Bibliography

Assistant Chief of Staff for Installation Management (ACSIM), Army Regulation (AR) 420-49, *Utility Services* (Headquarters, Department of the Army [HQDA], Washington, DC, 1997).

ACSIM, *Army Barracks Master Plan* (HQDA, 2003).

ACSIM, *Army Family Housing Master Plan, FY 04-09* (HQDA, 2004), p 9.

ACSIM, *Assistant Chief of Staff of Installation Management website* (2004).

Beranek, D.A., *Sustainable Design and Development* (Headquarters, U.S. Army Corps of Engineers [HQUSACE], Washington, DC, 2003), p 2.

Brown, L.R., *How Water Scarcity Will Shape the New Century* (Stockholm Water Conference, Stockholm, Sweden, Earth Policy Institute, 2001).

Brownlee, H.R.L. a. G.P.J.S., *The United States Army 2004 Posture Statement* (2004).

Bush, G.W., *Energy Conservation at Federal Facilities* (Office of the Press Secretary, The White House, Washington, DC, 2001), p 1.

Campbell, C.J., *The Coming Oil Crisis* (Multi-Science Publishing Co. Ltd and Petroconsultants S.A., Essex, UK, 2004).

Campbell, C.J., and J.H. Laherrere, “The End of Cheap Oil,” *Scientific American* (1998), pp 78-83.

Carr, M., *DOD Energy Manager’s Handbook* (Department of Defense [DOD], Arlington, VA, 1996).

CEHSC-P, *The DA Building Energy Monitor Handbook* (HQUSACE, 1989).

CIA, *Global Trends 2015: A Dialog About the Future with Non-Government Experts* (National Foreign Intelligence Board, Washington, DC, 2000), p 98.

Culp, C.H., “Continuous Commissioning Saves Energy,” *Proceeding of the Army Worldwide Environmental and Energy Conference* (Brooks Energy and Sustainability Laboratory, Texas A&M University, Atlanta, GA, 2000).

HQDA, *The Army in 2020 Functional Area White Papers* (2004).

Deffeyes, K.S., *Hubbert’s Peak* (Princeton University Press, Princeton, NJ, 2001).

DOE, "Federal Energy Management and Planning Programs," *Code of Federal Regulations*, 10 CFR 436 (1996).

DOE, "Executive Order 13123: Greening the Government Through Efficient Energy Management," *Guidance Documents for Federal Agencies* (December 2000).

Energy Information Administration (EIA), *Country Analysis Briefs: OPEC Fact Sheet* (U.S. Department of Energy, Washington, DC, 2002), p 8.

EIA, *Annual Energy Outlook 2004* (DOE, Washington, DC, 2004).

EIA, *International Energy Outlook 2004* (DOE, Washington DC, 2004), p 256.

EPA, *Putting Energy Into Profits: ENERGY STAR Guide for Small Business* (EPA, Washington, DC, 2004), p 31-32.

Federal Energy Management Program (FEMP), *Annual Report to Congress on Federal Government Energy Management and Conservation Programs Fiscal Year 2000* (DOE, Washington DC, 2002), p 210.

FEMP, *Guidance on Life-Cycle Cost Analysis Required by Executive Order 13123* (8 January 2003).

Flanders, S., R. Schneider, et al. *Sustainable Project Rating Tool* (HQDA, Washington DC, 2000).

Fournier, D., *Army Energy in the 21st Century, A Plan for the Future* (Building Research Council, University of Illinois at Urbana Champaign, IL, 2002).

HQDA, AR 11-27, *Army Energy Program* (HQDA, Washington DC, 1997).

HQDA, *HQEIS Real Property Inventory Data* (HQDA, Washington DC, 2003).

Headquarters Redesigned Army DUERS Data System (HQRADDS) (HQDA, Washington DC, 2002).

Hurd, Brian, Leary et al., "Relative Regional Vulnerability of Water Resources to Climate Change," *Journal for the American Water Resources Association*, vol 35, No. 6 (December 1999), pp 1399-1409

Installation Management Agency (IMA), Installation Management Agency website (2004).

IPMVP (International Performance Measurement and Verification Protocol), *FEMP Measurement and Verification Guideline for Federal Energy Projects and the International Performance Measurement and Verification Protocol*, accessible through URL: http://www.ipmvp.org

Johnson, J.A., A. Cowan, et al., *Advanced Buildings: Energy Benchmark for High Performance Buildings* (New Buildings Institute, Inc., White Salmon, WA, 2003).

Joint Chiefs of Staff, *National Military Strategy of the United States of America* (2004).

Laherrere, J. *Hydrocarbon Resources: Forecast of Oil and Gas Supply to 2050* (Ministry of Petroleum and Natural Gas, Petrotech, New Delhi, 2003).

Lin, Mike C.J., Dale Herron, David M. Schwenk, Chang W. Sohn, Eileen Westervelt, Thomas Hartranft, Thomas D. Miller, Nicholas Josefik, Joseph Bush, and Patricia A. Kemme *Systems-Level Energy Audit for Main Complex, Construction Engineering Research Laboratory, Champaign, IL* (Engineer Research and Development Center (ERDC)Construction Engineering Research Laboratory [ERDC-CERL], August 2003), p 84.

Marrs, C.R., *OSD Energy Management Framework* (ODUSD[I&E], 2002).

NAS (2002), *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism* (The National Academies, Washington, DC), p 29.

National Energy Policy Development Group, *National Energy Policy* (2001).

Office of the Secretary of Defense (OSD), *Installation Energy and Water Management Framework* (Department of Defense, Washington, DC, 2003), p 15.

Pacific Northwest National Laboratory (PNNL), *Long Range Energy Management Plan* (PNNL, Richland, WA, 2003), p 6.

Public Law (PL) 106-398, Section 2812, H.R. 5408, *Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001*.

Postel, S., *Pillar of Sand—Can the Irrigation Miracle Last?* (W.W. Norton & Co., New York, 1999).

Roberts, A., and G.L. Hunt, *What's Going on with Coal Prices?* (Henwood Energy, 2004).

Romm, J.J., and C.B. Curtis, "Mideast Oil Forever?" *The Atlantic Monthly* (1996), pp 57-74.

Santosus, M., and J. Surmacz, *The ABC's of Knowledge Management* (2004), available through URL:
www.cio.com

Spain, T. Kenneth, et al., *The DOD Energy Managers Handbook*, 2d ed. (DOD, Washington, DC, 1999).

Turner, W.C., *Energy Management Handbook* (The Fairmont Press, Inc., Lilburn, GA, 2001).

U.S. Congress, *Energy Policy Act of 1992*, 42 U.S.C. Section 8256 (1992).

U.S. Congress *Conference Report Energy Policy Act of 2003* (Washington, DC, 2003).

U.S. Department of Energy (DOE), "Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings," *Code of Federal Regulations*, 10 CFR 435 (1988).

USACE *Project Management Business Process (PMBP) Curriculum* (HQUSACE, 18 March 2002).

U.S. Green Building Council (USGBC), *Leadership in Energy and Environmental Design (LEED)* (USGBC, Washington DC, 2000).

U.S. Military Academy (USMA), *Enhanced Use Leasing* (USMA, West Point, NY, 2002), p 68.

Weinhold, S., *Sale and Outlease of Army Assets Guide—2002* (HQDA, Washington, DC, 2002), p 1.

Westervelt, E.T., *REEP: Renewables and Energy Efficiency Planning Program*, ERDC/CERL Technical Note (TN) 03-2 (ERDC-CERL, Champaign, IL, June 2003).

Office of the Press Secretary, The White House, *Greening the Government through Efficient Energy Management*, Executive Order 13123 (Washington DC, 1999).

Office of the Press Secretary, The White House, *Greening the Government through Federal Fleet and Transportation Efficiency* (Washington DC, 2000), p 7.

Williams, D., *FY 2003 DOD Energy Management Data Report* (HQDA, Washington, DC, 2003).

Acronyms and Initialisms

Abbreviation	Spellout
ACSIM	Assistant Chief of Staff for Installation Management
AESC	Army Energy Steering Committee
AETAT	Army Energy Technical Assistance Team
AETDT	Army Energy Technical Development Team
AEE	Association of Energy Engineers
AFCESA	Air Force Civil Engineering Support Center
AFH	Army Family Housing
AFHC	Army Family Housing Construction
AFHMP	Army Family Housing Master Plan
AFV	Alternative Fuel Vehicles
AR	Army Regulation
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
BEM	Building Energy Manager
BMPs	Best Management Practices
BPA	Bonneville Power Administration
BUP	Barracks Upgrade Program
C2	Condition Code 2 for infrastructure
CAAP	Critical Asset Assurance Program
CCB	Construction Criteria Base
CDD	Cooling Degree Day
CEHNC	U.S. Army Corps of Engineers Huntsville Engineering and Support Center
CEHND	Corps of Engineers Huntsville Design
CEM	Certified Energy Manager
CERL	Construction Engineering Research Laboratory
CFC	Chlorofluorocarbons
CFR	Code of Federal Regulation
Clg.	cooling
CO_2	Carbon Dioxide
CONUS	Continental United States
CRS	Center for Resource Solutions
DA	Department of the Army
DD	Department of Defense form
DDC	Direct Digital Control
DEPC	Defense Energy Policy Council
DEPPM	Defense Energy Program Policy Memorandum
DESC	Defense Energy Support Center
DG	Distributed Generation
DLA	Defense Logistics Agency
DOD	Department of Defense
DODI	Department of Defense Instruction

Abbreviation	Spellout
DOE	Department of Energy
DSM	Demand Side Management
DSNG	Direct Supply Natural Gas Program
DUERS	Defense Utility Energy Reporting System
E Benchmark	Energy Benchmark
ECIP	Energy Conservation Investment Program
EIA	Energy Information Agency
Elec.	electricity
EMCS	Energy Management Control System
EO	Executive Order
EPA	Environmental Protection Agency
EPAct 2003	Energy Policy Act of 2003
ERDC	Engineer Research Development Center
ESPC	Energy Savings Performance Contract
EUI	Energy Use Intensity
EUL	Enhanced Use Leasing
FEDS	Facility Energy Decision System
FEMP	Federal Energy Management Program
Finc.	Financing
FLIS	Federal Logistics Information System
FY	Fiscal Year
GDP	Gross Domestic Product
Gen.	generated
GHG	Green House Gas
Govt.	government
GSA	General Services Administration
GWh	Giga Watt-hour (10^9) watt-hours
HCX	Huntsville Engineering and Support Center
HDD	Heating Degree Day
HERS	Home Energy Rating System
HQEIS	Headquarters Executive Information System
HQRADDS	Headquarters Redesigned Army DUERS Data System
Htg.	heating
I&E	Installations and Environment
IAQ	Indoor Air Quality
IECC	International Energy Conservation Code
IMA	Installation Management Agency
Invest.	Investment
ISR	Installation Status Report Database
IUMP	Installation Utilities Management Plan
LCC	Life Cycle Cost
LDC	Local Distribution Company
LEED	Leadership in Energy and Environmental Design
LPG	Liquefied Petroleum Gas (mixture of propane and butane)
M	Million
MCA	Military Construction, Army funds appropriation

Abbreviation	Spellout
MILCON	Military Construction
MSR	Million Solar Roofs Initiative
MW	1 million watts
NAG	Natural Gas
NAS	National Academy of Sciences
NG	Natural Gas
NIST	National Institute of Standards and Technology
NSNs	National Stock Numbers
O&M	Operations and Maintenance
OACSIM	Office of the Assistant Chief of Staff for Installation Management
OCE	Office of the Chief of Engineers
OMA	Operations and Maintenance Army
OUSD(A&T)	Office of the Undersecretary of Defense, Acquisition and Technology
PA	Energy Manager Project Assistant Software
PDASA	Principal Deputy Assistant Secretary of the Army
PEMFC	Proton Exchange Membrane Fuel Cell
PMBP	Project Management Business Process
PNNL	Pacific Northwest National Laboratory
Poll.	pollution
POMs	Program Objective Memorandums
PPG	Petroleum Propane Gas
PV	Photovoltaic
PV	Present Value
QOLED	Quality of Life Enhancement, Defense funds appropriation
R&D	Research and Development
RCI	Residential Communities Initiative
RDTE	Research and Development, Test and Evaluation
Reduct.	reduction
REEP	Renewables and Energy Efficiency Planning Program
REM	Resource Energy Manager
SI	Standard International units
SIR	Savings to Investment Ratio
SIR*	Modified Savings to Investment Ratio with maintenance costs included in investment
SPB	Simple Payback
SPB*	Modified Simple Payback with maintenance costs included in investment
SPiRiT	Sustainable Project Rating Tool
SRM	Sustainment, Restoration & Modernization Program
TBtu	1 Trillion British Thermal Units
TEMF	Tactical Equipment Maintenance Facilities
TES	Thermal Energy Storage
UESC	Utility Energy Service Contract
URL	Uniform Resource Locator
USGBC	United States Green Buildings Council
VOLAR	Volunteer Army
WBDG	Whole Building Design Guide
WWW	World Wide Web

Appendix A: World and Domestic Petroleum and Natural Gas Situation

World oil production is projected to peak in the next decade and subsequently decline (Campbell and Laherrere 1998) (Deffeyes 2001) (Laherrere 2003) (Campbell 2004). In fact, non-OPEC conventional oil production may already be at its peak. In crude oil markets, uncertainties surround continued unrest in many of the key producing regions. Oil exports from Iraq are continual targets for disruption. Recent attacks in Saudi Arabia, while not specifically targeted on oil facilities, naturally generate worry among oil traders, particularly given that most of the world's remaining spare capacity is located there. Oil flow from Venezuela was disrupted in 2003 and the decision to hold a Presidential recall referendum there has temporarily calmed worries about the possibility of another stoppage in that country's oil production or exports. Venezuela is not out of the woods yet and problems could return closer to the mid-August 2004, scheduled date for the vote. Likewise, the early termination of a strike in Nigeria temporarily reduced fears of a reduction in that OPEC country's production, but concerns may return as well. These factors, and other, can lead to continued volatility in oil supplies and pricing.

Currently, world oil demand is price sensitive. Continued high prices may lead to inflationary induced recessions. This could lead to a drop in demand, causing the price of oil to fall, ultimately leading to general cycles of "boom and bust" in both oil pricing and economies. Achieving stability in the oil market depends on the effectiveness of OPEC's control of production by its member nations. This has increasingly fallen into the province of the one country with excess capacity, Saudi Arabia. The rest of the OPEC nations are already at maximum production. Iraq also has significant excess capacity (EIA 2002), but achieving this level of oil production in the post war climate is proving to be problematical. Should Saudi Arabia decide to prematurely trim its recent surge in production, oil prices will again begin to rise. Still, this analysis assumes that oil production capacity is available to meet demand. The coming oil crisis within the decade will be different and enduring; demand will permanently outstrip supply, creating economic and political discontinuity of historic proportions as the world adjusts to a new energy environment.

Domestic oil production in both the lower 48 United States and Alaska continues to decline. Most, if not all, non-OPEC oil producers have also passed or are currently reaching their peaks of production. While there are great expectations for petroleum from the Caspian Sea region, resources there may not be at the level hoped for and the pipelines to get it to market must pass through some very troubled areas. Depending on how this plays out, it is a good bet that within the next several years or so non-OPEC conventional oil production will have peaked. Consequently, OPEC will be in firm control of the marginal oil production (and prices). The Energy Information Administration (EIA, 2004) projects an increase in oil demand and production of 56 percent in the next 20 years. Meeting this demand is virtually impossible. Actual discoveries peaked in the 1960s and have in no way indicated a world oil reserve potential in the range projected by the EIA. Accepting overly optimistic projections of this magnitude is strategy that the U.S. military cannot adopt.

The United States now imports over 59 percent of its crude oil supply. This percentage is expected to increase throughout the foreseeable future up to about 70 percent by 2025 (EIA 2004). The nation is becoming more vulnerable and is ill equipped to deal with the potential economic and geopolitical implications of oil market volatilities (Romm and Curtis 1996). Once world demand exceeds total supply, we will start to pay monopoly and scarcity rent on the price of oil. Due to the ready substitutability between oil and natural gas in industry and power generation, the price of natural gas will quickly reflect changes in the price of oil. Although current prices for natural gas exceed those for oil, this offers little hope to the United States' transportation system, which relies on petroleum products for 97 percent of its energy. Coal prices are also somewhat susceptible to price increases in natural gas and oil, as shown by the current rise in Eastern coal prices (Roberts and Hunt 2004).

The United States is also potentially headed for a crisis in natural gas supply. Analysts estimate that the U.S. natural gas supply last year fell 3 percent, and will decline another 1 percent this year. Natural gas production in the lower 48 United States and Canada is dropping. There is currently no way to get Alaskan and other North Slope natural gas to market. U.S. basins have matured and premium reservoirs have been depleted. The United States must now replace about 29 percent of its natural gas production each year due to depletion of existing wells. The decline rate is increasing over time and projected to exceed 32 percent in a few years. As a result, natural gas prices have become very volatile over the past several years, a trend that will continue. We have seen a significant upward shift in prices starting in January 2003, which will last for 3 to 4 years. This upward price trend stems in part from a huge shortfall in supplies available to the U.S. market, which may be in the range of 1 trillion cu ft in 2004. This would be true even if there were no increase in domestic demand. Unfortunately, at the same time supplies are diminish-

ing, demand is certain to grow due to the impact of 200,000 MW of natural gas-fired generating capacity that has been added to the grid since 1999, and also due to tightened NOx restrictions going into effect in 2003 and 2004. The weather each year will play a major role in determining natural gas prices and reserve margins. High prices are already leading to market shifts with major closures of fertilizer manufacturing plants. Also, some industrial users are able to switch to oil.

As traditional sources of production become less productive, the United States needs to do several things: expand unconventional production, push the limits of technology in the deepwater Gulf of Mexico, continue to import natural gas into the United States from Canada, provide access to reserves on state and Federal lands, expand liquefied natural gas capacity, and, once commercially viable, tap into the supplies of natural gas in Alaska. Bringing Alaskan natural gas south will require the construction of a pipeline estimated to cost $10-20 billion. The proposed Energy Policy Act of 2003 has provisions to encourage an Alaskan natural gas pipeline with support of $18 billion.

Net imports of natural gas from Canada are projected to remain at about the 2002 level of 3.6 trillion cu ft through 2010 and then decline to 2.6 trillion cu ft in 2025. Based on data and projections from the Canadian National Energy Board and other sources, Canadian natural gas production will be lower than expected, particularly coal bed methane and conventional production in Alberta.

There are plentiful supplies of natural gas in the world. Unfortunately, up to half of the natural gas supplies in the world are considered to be “stranded” (too far from markets to be economically harvested). One solution is to increase the use of liquefied natural gas (LNG) and expand LNG terminals on the U.S. coast. The four existing U.S. LNG terminals (Everett, MA; Cove Point, MD; Elba Island, GA; and Lake Charles, LA) all are expected to expand by 2007. Additional facilities are expected to be built in the lower 48 States, serving the West Coast, Gulf, Mid-Atlantic, and South Atlantic States, with a new small facility in New England and a new facility in the Bahamas serving Florida via a pipeline. Another facility is projected to be built in Baja California, Mexico, serving the California market. Total net LNG imports are expected increase significantly in the future, as they must to meet current and expected demand growth in the United States.

Petroleum products and natural gas represent about two-thirds of the nation’s energy supply. Based on the above, the outlook for both of these energy sources is not bright. Now is the time to consider both short and long term solutions for our military installations. The Army must insulate itself from the potential price spikes, disruptions, and shocks that may strike the general economy as the world energy situation plays out over the next decade or so as we move to a new energy reality.

The solution is a transition to safe, reliable, secure, and efficient energy systems and technology. This is both a supply- and demand-side issue requiring integrated solutions and thoughtful planning and execution. Accelerated transition to renewables, distributed cogeneration, and high efficiency energy technologies and buildings should be the foundation of any future energy plans.

Appendix B: World and Domestic Water Situation

Water scarcity may be the most underestimated resource issue facing the world today. World water use has tripled in the past 50 years. Current water usage is 70 percent for irrigation, 20 percent for industry, and 10 percent for residential purposes. Forty percent of our food supply now comes from irrigated land, showing increased reliance on irrigation in the world food economy. While the demand continues to rise, the basic amount of fresh water supply provided by the hydrological cycle remains static. There are two principle signs of stress as the demand for water outruns the supply. One is rivers running dry and the other is falling water tables (Brown 2001).

Many of the world's major rivers now fail to make it to the sea, or there is very little water left in them when they do reach the sea. The Colorado River, the major river in the southwestern United States, rarely reaches the Gulf of California. It is drained dry to satisfy the agricultural needs in Colorado, Arizona, and, California. The Nile River has little water left in it when it reaches the Mediterranean. The Ganges, shared by India and Bangladesh, is almost dry when it reaches the Bay of Bengal. China's Yellow River, the cradle of Chinese civilization, first ran dry in 1972, but beginning in 1985, it has run dry for part of each year.

Water tables are falling on every continent. Water tables are falling in several of the world's key farming regions, including under the North China Plain, in the Punjab, and in the U.S. southern Great Plains, a leading grain-producing region. Aquifer depletion is a new global problem that has emerged in the last half century. This is because it is only during this period that the pumping capacity has existed to deplete aquifers. In the Punjab, the breadbasket of India, the water table is falling by half a meter per year. A similar situation exists in China. The Chinese government has reported that the aquifer under the North China plain, which produces 40 percent of China's grain harvest, is falling by 1.5 meters per year. The size of the world water deficit—the amount of over pumping in the world—using data for India, China, the Middle East, North Africa, and the United States, is estimated to be 160 billion tons of water, which equals 160 billion m^3 (Postel 1999). The United State's portion of the water shortfall is about 2,700 billion gallons per year or about 7 percent of the total.

Future wars in the Middle East are more likely to be fought over water than over oil. The competition for water in the Middle East is going to take place in the world's grain markets. The countries that are financially strongest, not those which are militarily the strongest, will win this competition. Water is beginning to shape international grain trade patterns in much the same way that land scarcity has historically.

One of the wild cards in the water situation and one of the things that makes assessing the future water situation difficult is climate change. First level indicators of climate change are carbon emissions, atmospheric CO_2 levels, and rising temperatures (the 15 warmest years of the last century have all come since 1980) with 2003 being the warmest. There has been a very distinct upturn in global temperature. One of the second level effects of climate change is ice melting.

In the Arctic Ocean, the ice sheet has shrunk by nearly 40 percent over the past 35 years. A recent Norwegian study indicates that in another half century there might be no ice left in the Arctic Ocean in the summertime. The melting of ice on land leads to rising sea levels, an event that is now occurring. Another thing that is going to affect water supply, particularly for agriculture, is the temperature rise in mountainous regions.

A rise in average temperature in mountainous regions of 1 or 2 degrees Celsius can substantially alter the precipitation mix between rainfall and snowfall, with substantial increases in the amount of precipitation coming down as rain and a reduction in the amount coming down as snow. This change translates into more runoff and more flooding during the rainy season and less water being stored as snow and ice in the mountains for use in the dry season. The snow pack acts as a reservoir, which is slowly draining. Ice is melting in all the major mountainous regions of the world. In the United States, Glacier National Park located in the State of Montana, had 150 glaciers in it a century or so ago. Now there are only 50 and the U.S. Geological Service is projecting that in another 30 years there may not be any left at all. Ice melting is accelerating in the Andes and in the Alps, where there has been an enormous shrinkage in the snow/ice mass.

The snow/ice mass in the Himalayas, which is the third largest in the world after the two polar ice caps, is now beginning to shrink, and at an accelerating rate. Every major river in Asia originates in that snow/ice mass. These include the Indus shared by India and Pakistan, the Ganges shared by India and Bangladesh, the Amu Darya in Central Asia, which feeds the Aral Sea, the Mekong in Indochina, and the Yangtze or Yellow River and the Huang Ho in China. They all come out of that central Asian snow/ice mass and are all under stress. This could alter the hydrology of Asia leading to more runoff during the summer rainy season, and less

snow melt to feed rivers during the dry season. Hydrological poverty will be inevitable; unlike other forms of poverty, it will be inescapable. The amount of water available in any particular country cannot be readily altered, but it can be used more efficiently.

As noted above, the United States is not immune to these same issues. Over the next decade, the United States is expected to move from a high water availability nation to an average water availability nation (CIA 2000). In addition to climate change issues and over pumping of aquifers for irrigation and domestic water supply, a major contributor in the United States to water problems is the way land is developed. Sprawling growth is paving over more and more wetlands and forests contributing to the depletion of our water supplies (Otto, Ransel et al. 2002). The arid West is not alone in facing critical water shortages.

The rapidly suburbanizing Southeast is now in serious trouble, as are many other formerly water-rich regions of the country. Over the last decade, studies have linked suburban sprawl to increased traffic and air pollution as well as the rapid loss of farmland and open space. Sprawl not only pollutes water supplies, it also reduces those supplies. Impervious surfaces—roads, parking lots, driveways, and roofs—replace meadows and forests and rain no longer can seep into the ground to replenish aquifers. Rainwater is swept away by gutters and storm sewer systems. The sprawling of America has translated into a significant loss of valuable natural resources. Undeveloped land is valuable not just for recreation and wildlife, but also because of its natural filtering function. Wetlands act like sponges, absorbing precipitation and runoff and slowly releasing it into the ground. More than one-third of Americans get their drinking water directly from groundwater, and the remaining two-thirds depend on surface water.

Surface water is also affected because, typically, about half of a stream's volume comes from groundwater. Figure C1 shows the potential impacts of climate change and land settlement patterns on the future U.S. groundwater supplies (Hurd, Leary et al. 1999). Vulnerability ranges were defined as the ratio of average groundwater withdrawals (Q_{GW}) in 1990 to annual average baseflow (Q_{Base}), reflecting the extent that groundwater use rates may be exceeding recharge. High depletion rates are vulnerable to long-run changes in hydrology and future lack of supply. Much of the U.S. West, Southwest, central plains, and Florida are highly vulnerable.

The level of development is an indicator measures the ratio of current water withdrawal to mean annual unregulated streamflow. Watersheds with low water availability and high demand are vulnerable, i.e., in areas of development intensive use of off-stream water generally occurs resulting in decreased water availability. With a reduction in streamflow, either via seasonal or dramatic climatic change, an in-

crease in both in-stream and off-stream uses will occur, especially in areas of high development and high irrigation. Therefore, the potential impact is high for a military mission if and when it is in an area with vulnerable watersheds. Water availability could be compromised resulting in a negative impact on soldiers, training, carrying capacity, and threatened and endangered species. Vulnerability levels are defined as the ratio of total annual surface and groundwater withdrawals in 1990 (Q_W) to unregulated mean annual streamflow (Q_S). This ratio reflects the extent to which a watershed's water resources are developed for consumptive uses. The withdrawals in many areas have been increasing with time as development occurs. Figure C2 shows the vulnerability levels of the U.S. West, Southwest, and central plains.*

Military installations are not immune to the development practices that exacerbate water issues. Coastal installations are subject to the result of rising sea levels and aquifer drawdown, which leads to salt water intrusion into the coastal water tables. Western Army installations are vulnerable to future water shortages and the requirement to reduce their impacts on local hydrological systems. A classic example is Fort Huachuca and its requirements to ameliorate the impacts of urban growth in the region on the local watershed. Water availability is an increasing domestic and international problem. Indeed, it may even be more important than energy since there are two Earth resources that are absolutely essential to human existence—water and soil (Youngquist 1997). From this reality comes the imperative to use water resources effectively and efficiently and the reasons why the Army is concerned with this issue. Implementing best management practices for water is an imperative both from directives and enlightened self interest.

* Figures C1 and C2 are reprinted here by permission of the American Water Resources Association (AWRA) from: Brian Hurd, Neil Leary, and R. Jones, "Relative Regional Vulnerability of Water Resources to Climate Change," paper 99084, *Journal of the American Water Resources Association* (AWRA, December 1999), vol 35, No. 6, pp 1399-1409.

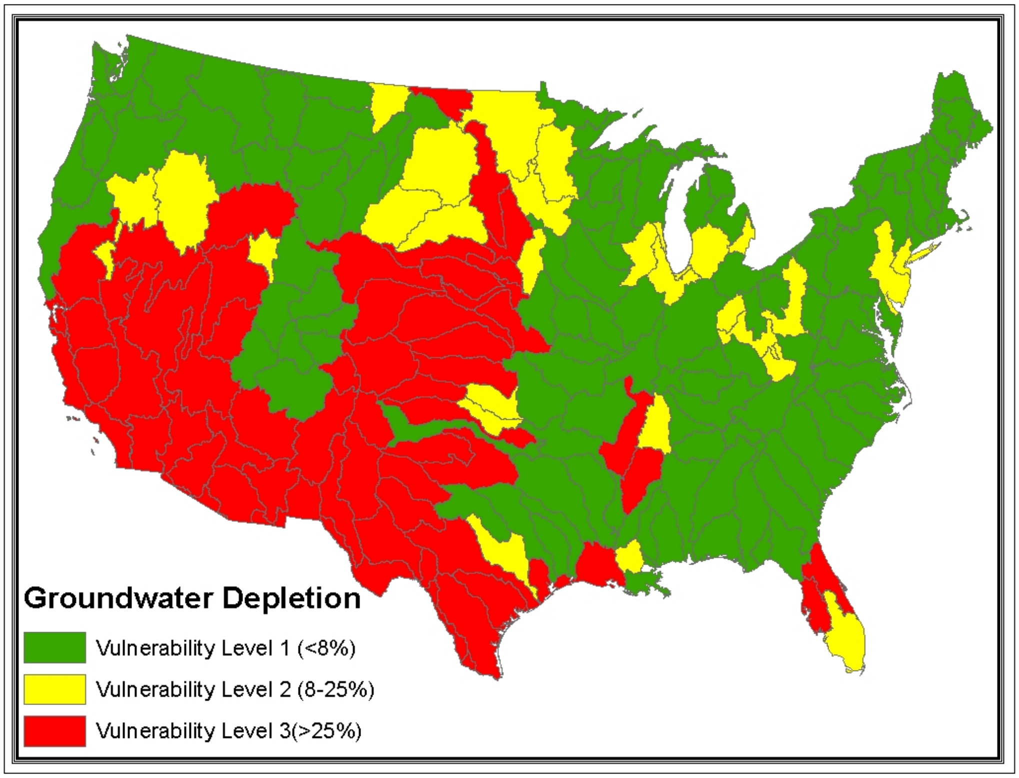

Figure C1. Vulnerability to groundwater depletion.

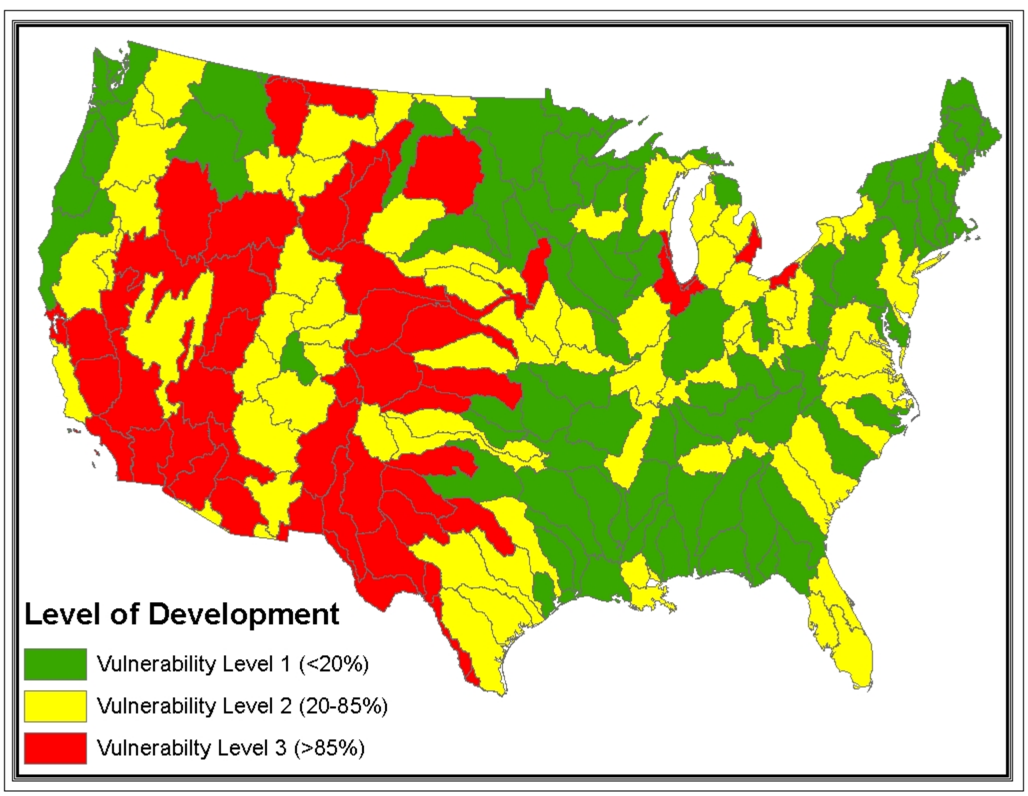

Figure C2. Level of development

Appendix C: Installation Utility Security Plan Checklist

Requirements of DEFENSE ENERGY PROGRAM POLICY MEMORANDUM DEPPM 92-1

Department of Defense Energy Security Policy (AR420-49 Facilities Engineering Utility Services implements DEPPM92-1 in the Army)

<u>**Installation Utility Security Plan Checklist**</u>

- ❑ **(Optional) Establish a Utility Security Planning Board (USPB)**

  (With Installation Commander or designated representative as chairman, and representation from each tenant/command to ensure a coordinated recovery plan.)

- ❑ **Conduct energy vulnerability analysis and annual review**
  - o Off Installation Transmission (number of service entrances, traffic load, condition/age of infrastructure).
  - o On Installation Distribution (condition/age of distribution and control).
  - o Identification of Critical base functions, facilities required to support those functions, necessity of energy requirements, and quantification of requirements.

- ❑ **Establish energy emergency preparedness and operation plans**
  - o Alternate modes of maintaining function:
    - Move to another location.
    - Perform task manually.
    - Generate power from redundant source (analyze options and impact on fuel, cost, and environment).

  - o Personnel recall procedures (staff/contractors involved, work assignments, method of contact).

  - o Identify key authorities to contact in an emergency, assign and coordinate radio frequencies for communication.

- Identify critical energy requirements to utilities service providers to ensure critical mission areas are recognized in the service restoration plans of those providers.
- Establish and maintain a technically accurate database on its portable emergency generators (location, size, fuel used, year installed, portability, last overhaul, maintenance schedule, emergency fueling plan).
- Establish a method for employing and maintaining these assets within their organizations or across service/Agency lines in an energy emergency.
- Negotiate mutual aid agreements with local communities to minimize loss of life.
- Update data and distribute annually.
- Identify local sources of labor, material, equipment, energy providers for use in recovery operations.
- Provide annual training to management personnel on details of emergency plan and procedures they must follow.
- Incorporate security planning into construction projects.

- [ ] **Develop and execute remedial action plans to remove unacceptable risks**

- Identify risks, quantify risk, establish cost/benefit and threshold criteria, prioritize, schedule correction plan with milestones.
- Provide for budgeting when significant expenditures are required for remedial action.
- Review milestones and progress annually.

Appendix D: Economic Calculations

Simple Payback

Simple payback (SPB) periods are calculated for all of the projects and for each installation. Payback periods can vary greatly from one installation to the next for a single project, primarily due to energy cost variations and climatic influences. Simple payback analysis is a rather simplistic way to gauge the economics of a project because it does not account for changes in energy prices over time. However, if energy prices remain stable, it provides a rough idea of how fast capital costs will be recovered.

Simple Payback is calculated as follows:

$$\text{Simple Payback} = \text{SPB} = \frac{\text{Total First Cost Investment}}{\text{Annual Savings}}$$

where Simple Payback units are in years.

Total First Cost Investment ($) = (# of units x adjusted unit cost) + SIOH + design cost

Annual Savings ($) = Annual fuel savings ($) + Annual non-fuel savings or cost ($)

For the analysis of this report a modified metric was defined as SPB,* which includes maintenance costs in the total investment. This was done to better reflect the third party financed energy projects, which include maintenance and thus must be budgeted for, to enable valid comparisons between in-house and third party financed costs, and as a recognition that savings are dependent on adequate maintenance and will not be achieved without it. Thus:

$$\text{SPB}^{*} = \frac{\text{First Cost Investment} + \text{PV of Life Cycle Maint. Cost}}{\text{Annual Savings}}$$

Savings to Investment Ratio

The SIR is one way to gauge the merits of a project over time. The SIR calculation use discount factors (which include fuel escalation projections) to estimate the value

of the fuel saved over time to present worth terms. The SIR divides the total net discounted savings (both fuel and non-fuel savings) by the total investment of the ECO. Thus, if the total net discounted savings over the life of the project equal the cost of the project, the project has an SIR of 1.0.

SIR is calculated as follows:

$$\text{Savings Investment Ratio} = \frac{\text{Total Net Discounted Savings}}{\text{Total First Cost Investment}}$$

where:

Savings Investment Ratio is a dimensionless number.

Total Net Discounted Savings = Discounted resource savings over the life of the project + Discounted non-energy savings over the life of the project

Total First Cost Investment = (# of units x adjusted unit cost) + SIOH + design cost

Again, a new metric was defined as SIR* where the present value of life cycle maintenance was added to the first cost investment:

$$\text{SIR*} = \frac{\text{Total Net Discounted Savings}}{\text{Total First Cost Investment} + \text{PV of Life Cycle Maintenance Cost}}$$

Appendix E: Best Management Practices for Water

Public Information and Education Programs. Educating users is very important if water conservation technologies and methods are to be successful. Experience shows that it is not enough to install a retrofit or water-saving technology in a facility. New operational procedures, retrofits, or replacements are most effective when employees, contractors and the public know what the new technology or methods are and how to use them properly.

Distribution System Audits, Leak Detection and Repair. A distribution system audit, leak detection, and repair program can help facilities reduce water losses and make better use of limited water resources. At the average, circa 1940s, Army facility it is very likely that much more than 10 percent of your total water production and purchases are lost to system leaks. Regular surveys of distribution systems should always be conducted prior to obtaining additional supplies and can have substantial benefits.

Water Efficient Landscape. In most locations, traditional landscapes require supplemental water to thrive. For example, Kentucky bluegrass is native to regions that receive in excess of 40 in. per year of precipitation. To make up the difference between a plant's water requirement and the natural precipitation in your area, additional water must usually be added in the form of irrigation. Actions include appropriate plant material for the climate and use of efficient irrigation systems.

Toilets and Urinals. Current Federal law requires that residential toilets manufactured after 1 January 1994, must use no more than 1.6 gallons per flush (gpf). Commercial toilets manufactured after 1 January 1997, must use no more than 1.6 gpf and urinals must use no more than 1 gpf.

Faucets and Showerheads. Tremendous amounts of water and energy are wasted using non-water-efficient faucets and showerheads. EPAct 1992 mandates that all lavatory and kitchen faucets and aerators manufactured after 1 January 1994, must use no more than 2.2 gpm, showerheads must use no more than 2.5 gpm. Many applications can use even less flow from faucets and aerators are avail-

able as low as 0.5 gpm. Judicious replacement of aerators and showerheads can save significant amounts of potable water.

Boiler/Steam Systems. Boiler and steam generators are commonly used in large heating systems, institutional kitchens, or in facilities where large amounts of process steam are used. This equipment consumes varying amounts of water depending on the size of the system, the amount of steam used and the amount of condensate return. Maintaining high levels of condensate return and low levels of blow down can significantly reduce water consumption result in lower repair costs.

Single-Pass Cooling Systems. Single-pass or once through cooling systems provide an opportunity for significant water savings. In these systems, water is circulated once through a piece of equipment and then disposed down the drain. To remove the same heat load, single-pass systems use 40 times more water than a cooling tower operated at 5 cycles of concentration. The types of equipment that typically use single-pass cooling are: CAT scanners, degreasers, hydraulic equipment, condensers, air compressors, welding machines, vacuum pumps, ice machines, x-ray equipment, and air-conditioners. Surveys and audits can find these types of equipment and recommend viable alternatives, saving water and energy.

Cooling Tower Systems. Cooling towers help regulate temperature by rejecting heat from air-conditioning systems or by cooling hot equipment. In doing so, they use significant amounts of water. The thermal efficiency, proper operation, and longevity of the water cooling system all depend on the quality of water and its reuse potential. In a cooling tower, water is lost through evaporation, bleed-off, and drift. To replace the lost water and maintain its cooling function, more make-up water must be added to the tower system. Sometimes water used for other equipment within a facility can be recycled and reused for cooling tower make-up with little or no pre-treatment. Effective water treatment programs not only save water, but extend the life of the equipment and reduce maintenance costs.

Miscellaneous High Water-Using Processes. Many other high water using processes are found at Army facilities, including kitchens and food processing, cleaning/laundry services, laboratories, and other environmental uses. High water using processes should be identified and analyzed for potential water and energy efficiency improvements.

Water Reuse and Recycling. Many facilities may have water uses that can be met with nonpotable water. Due to unclear terminology, several entirely different water reuse concepts are often confused. Some of these concepts and appropriate uses include:

- Filtered but otherwise ***untreated*** water, which can often be easily reused on-site for nonpotable uses without being discharged to the wastewater system. Examples include using rinse water from laundries or car washes for the next wash process, or cooling tower condensate distributed for adjacent landscape irrigation.
- Wastewater that is ***treated*** to meet high standards at a wastewater treatment plant can then be ***redistributed*** for nonpotable uses. Pursuant to health regulations established under the Clean Water Act and various States' regulations, this water is allowed for nonpotable uses, including landscape irrigation, decorative water facilities, cooling towers and other industrial processes, fire sprinkler systems, and as flush water for toilets and urinals. Although treatment and distribution of this water can be expensive, it is usually cost-effective when compared to the costs to develop additional potable water supplies.
- Water from showers/baths and clothes washers (not used to wash diapers or process food), which can be used for landscape irrigation. Use of this water at Army facilities is generally not recommended because of high capital costs and health and safety issues.

Appendix F: Installation Long Range Energy Management Plan Format

This format was developed by the Pacific Northwest National Laboratory.

Executive Summary

- Summary of site mission and how energy resource efficiency supports the mission.
- Goals and objectives of the *Long Range Energy Management Plan* (the *Plan*).
- Strengths of current energy management program and efforts.
- Major challenges and goals for the upcoming Fiscal Years.
- Major action items to meet challenges and goals.
- Message from the Garrison Commander

1. **Introduction**
   1.1. Statement of the primary mission of the installation and how energy resource efficiency efforts support the mission.
   1.2. Purpose and objective of establishing this Energy Management Plan, time period covered, planned updates, etc.
   1.3. General facility or site description including history, location, use, etc.
2. **Energy Management Policy**
   2.1. Summary of goals and requirements of Energy Policy Act of 1992 and Executive Order 13123 or superseding guidance or legislation.
   2.2. Summary of the goals and requirements of Army Regulation 11-27.
   2.3. A summary of any established installation specific goals, directives, and policies.
   2.4. How energy management and energy policies relate to—or are integrated with—the installation environmental policies, sustainability, and/or sustainable installation program.
3. **Energy Management Organization**
   3.1. Identification of organizational structure that defines energy management responsibilities at all organizational levels. This includes identification of the energy manager and energy management councils/committees as well as the lines of responsibility for facility/building management, energy management, operations and maintenance (O&M), retrofits, new building design,

contracting for performance type contracts, analyzing utility bills, and leasing of space.

3.2. Indication of responsibilities of various parties, co-lateral duties, etc. Identify any Resource Efficiency Managers (REMs) or other contract staff. Indicate whether energy efficiency is part of performance appraisal or performance award system for each party (i.e., accountability).

3.3. Identification of any goals or actions needed to improve current organization, responsibilities, coordination and interaction, and accountability.

4. Energy and Water Use and Cost Tracking Systems

4.1. Installation glide path of historical energy use from FY1985 to present. Provide narrative on how the installation has achieved the progress to date, discuss any apparent anomalies in the data, and how the EO 13123 goals will be accomplished.

4.2. Identification of any renewable energy sources at the installation including self-generated (solar, PV, wind, etc.), or purchased renewable energy.

4.3. Estimation of how water consumption and cost are tracked.

4.4. Information and graphs of usage by fuel type, cost of fuel used, types of buildings or individual buildings, end-use such as lighting, HVAC, usage comparison to similar buildings, etc. Information and graphs of load profile, peak times, etc. Details will be included in Appendix A.

4.5. Description of utility rate schedules. Information on most recent evaluation or discussions on rate schedule, billing structure, demand charges, etc. Information on historical rate increases, rate structure changes, etc.

4.6. Information on industrial and process energy usage. Identify processes used, latest change, or updating of processes, and usage attributed to processes.

4.7. Identification of significant non-building and non-central plant energy use including street and security lighting, motors/pumping and other process energy. Quantify energy use if possible.

4.8. Description of utility reimbursable customers, historical energy use, and current recovery rates.

4.9. Identification of actions needed to establish accurate baseline information, tracking mechanisms and billing systems, billing and rate analysis and discrepancy resolution, and graphing of energy usage and costs (energy accounting system).

5. Building Stock Information

5.1. Description of buildings intended to be covered by this Energy Management Plan. Include general information by building such as location, age, construction type, condition, owned or leased, square footage, etc. Categorize each building by fuels; identify building-level metering and current FY fuel usage by fuel type for those buildings that are metered. Include a spreadsheet with all buildings currently in the real property database in Appendix B.

5.2. Identification of any buildings the agency has excluded from mandates of the EPACT under Section 548(a) because of energy intensive activities and any sites that fall under the "Industrial" classification.

5.3. Identification of any actions needed to establish or improve information availability, data collection, and data updates.

6. Utilities Infrastructure and On-Site Generation

6.1. Description of central plants and their distribution systems.

6.2. Listing of buildings served by central plants. Identify those that are heated, those that are cooled, and those that are served steam or hot water for domestic or process use. Include a map of the distribution systems in Appendix C

6.3. Description of the status of the installation Utility Modernization Program (UMP) activities, and how these projects will impact the energy consumption and/or costs.

6.4. Status of utilities privatization activities including electric distribution system, natural gas distribution system, water treatment and distribution system, and wastewater system.

6.5. Description of current capabilities for load control, peak shaving or valley filling, storage capability and capacity expansion, and on-site generation (how it is deployed). This should include any and all UPS and standby generation even if it is only used for standby generation, fuel cells, microturbines, and other technologies.

6.6. Description of energy management control system(s) (EMCS)/utility control systems (UCS), the buildings or systems served by EMCS/UCS, and the parameters that are controlled and measured in each building through the EMCS/UCS.

6.7. Identification of opportunities for EMCS/UCS or other load control/management.

7. Energy and Water Projects/Retrofits and Renovations

7.1. Listing and prioritization of energy efficiency projects to be designed and implemented between FY2003 and FY2010. Provide description of project, payback, SIR, implementation costs, energy savings and/or demand reduction, anticipated implementation year, and potential sources of funding/financing. Estimate impact on installation glide path FY2003 to FY2010. Include detailed descriptions of the projects in Appendix D.

7.2. Identification of activities to be undertaken to improve water efficiency. This includes the identification of Water Management Plans and implementing Best Management Practices for efficient use of water.

7.3. Identification of buildings to audit or survey each year for energy efficiency projects (approximately l0 percent of buildings or square footage of space per year). Identify buildings that have been audited and plans to audit remaining buildings.

7.4. Identification of any actions needed to establish or improve equipment replacement, renovation, and retrofit practices, take advantage of utility services, incorporate new technology, and purchase ENERGY STAR® products.

8. New Construction, and Major Remodels and Renovations

8.1. Description of the installation master plan including MCA construction, major renovations, and family housing construction (MCA only). Estimate impact on installation glide path from planned construction and renovations projects.

8.2. Description of current plans for privatization of family housing under the Residential Communities Initiative (RCI). Include information on the schedule for privatization, new units to be constructed, units to be renovated, planned or anticipated construction standards, and how utility services (commodity and distribution) will be acquired.

8.3. Procedures used to identify upcoming projects and opportunities to incorporate energy efficiency and water conservation in new construction, leased buildings, and major renovations to ensure that design and construction meets or exceeds installation sustainability standards (e.g., SPiRiT) and local code standards (e.g., Energy Star® buildings). Identify methods used to influence design standards, determine clauses to be incorporated into solicitation documents, and take advantage of design review services.

8.4. Identification of plans to incorporate combined heating/cooling, alternative fuels (e.g., biomass), geothermal or other highly efficient power systems into new and major renovation projects.

8.5. Explanation of plans to minimize use of petroleum-based fuels (including use of dual-fuel systems), to incorporate solar and other renewable energy sources, and to incorporate water conservation measures. Methods used to identify potential new technologies to accelerate commercial viability, and plan to submit proposals for new technology demonstration projects to the Department of Energy for funding.

8.6. Description of building commissioning program designed to ensure optimal functioning of energy using building systems, including clauses to be incorporated into solicitations, ESPC/UESC projects, and O&M contracts.

8.7. Identification any actions needed to establish or improve design practices, take advantage of design review services, and incorporate new technology.

9. Project Financing/Implementation/Resources/Budget Plan

9.1. Description of the status of the installation ESPC program, and how contractor resources will be leveraged to effect energy efficiency. Provide description of projects, payback, SIR, implementation costs, energy and cost savings—including demand reduction—and anticipated implementation year. Estimate impact on installation glide path FY2003 to FY2010. If there are institutional or site-specific issues that preclude the implementation of ESPC projects, describe in detail.

9.2. Description of the status of the installation Utility Energy Service Contracts (UESC), and how utility resources will be leveraged to effect energy efficiency. Provide description of projects, payback, SIR, implementation costs, energy and cost savings—including demand reduction—and anticipated implementation year. Estimate impact on installation glide path FY2003 to FY2010. If there are institutional or site-specific issues that preclude the implementation of UESC projects, describe in detail.

9.3. Description of the status of the installation Energy Conservation Investment Program (ECIP), or other appropriated funding sources. Provide description of projects, payback, SIR, implementation costs, energy and cost savings—including demand reduction—and anticipated implementation year. Estimate impact on installation glide path FY2003 to FY2010. Describe any other significant energy projects and describe their funding source (like force protection/appropriated funds, BPA, etc).

10. Incentives, Awards and Awareness Programs

10.1. Description of agency or site incentives program established to comply with Sec. 546(a)(1) of the EPACT to encourage more efficient use of energy and water. Identify ways staff is encouraged to recommend ideas for efficiency efforts and how ideas are evaluated.

10.2. Description of any nominations made over the past 3 years, and any awards received for the Secretary of the Army Energy and Water Management Awards.

10.3. Description of any nominations made over the past 3 years, and any awards received for the Federal Energy and Water Management Awards.

10.4. Identification of any existing Showcase facilities or candidates for future showcase facilities. These facilities are to highlight advanced technologies and practices for energy efficiency, water conservation, or use of solar and other renewable energy. Showcase facilities could highlight sustainable building design practices.

10.5. Description of continuing employee awareness programs and annual energy awareness activities or events, including Energy Awareness Month in October and Earth Day in April. Description of newsletters, articles, press releases, etc. used to internally distribute energy-related information.

10.6. Description of methods of involving and motivating staff and occupants in on-going efficiency programs.

10.7. Identification of any goals or actions needed to establish or improve incentives and awareness programs.

11. Training

11.1. Identification of staff who have attended workshops and/or received training in such areas as: Energy Management, Life Cycle Costing, Renewable Energy Technologies, Distributed Generation, Sustainable Design/Low Energy Buildings, Building Commissioning, Water Resource Management, Energy Efficiency Design, Operations and Maintenance, and other pertinent courses, such as those offered by USDOE/FEMP, GSA, Corps of Engineers, DOD, and AEE.

11.2. Description of Regional or IMA sponsored workshops, seminars, meetings, etc. conducted within the past 3 years or held on a routine basis (quarterly, annually, etc).

11.3. Identification of personnel designated as Certified Energy Managers or other certified professionals (e.g., PE, CLEP, etc.).

11.4. Identification of any actions needed to maintain or improve staff knowledge of efficiency practices.

12. Evaluation and Reporting

12.1. Description and samples of any monthly or quarterly reports submitted to Regional Headquarters/IMA or received from Management concerning energy and water use, and progress toward goals.

12.2. Process for providing monthly input to Army HQ RADDS reporting system and recommended actions to streamline data gathering and reporting. Identify buildings exempt from reporting (energy intensive facilities), industrial facilities, and process energy not reported. Describe process to account for reimbursable customers, and exclusions for customers that report their energy data separately (e.g., Commissary).

12.3. Description of methods of gathering and reporting data for Annual Energy Report and EO 13123 Implementation Plan.

12.4. Identification of recommended actions to streamline data gathering and reporting.

13. References

13.1. Listing of relevant documents/URLs and other references.

Attachment 1—SERO and Installation Points of Contact

Appendix A—Energy Use Data by Building and Fuel

Appendix B—Real Property Data

Appendix C—Central Plant Distribution System Map and Identification of Buildings Served

Appendix D—Description of Planned Energy-Related Projects FY2003-FY2010

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14. ABSTRACT

Army installations are essential to the development and sustainment of operational capabilities and readiness to serve and protect the nation and its interests. Installations are small cities with a full complement of facility types and utility requirements that necessarily use significant amounts of energy and water. To secure its mission, the Army must competently manage these facilities and utility assets and their consumption of resources. The management of these resources is multi-faceted and must incorporate diverse issues into a cohesive program. This work augments on-going energy and water management initiatives within the Army by developing a new candidate Army level strategy that responds to anticipated legislation; reflects current DOD and DA requirements, vision, and values in light of the current world situation; incorporates sound science and management principles; and organizes and focuses efforts into an integrated program.

15. SUBJECT TERMS

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